POPULAR SCIENCE

MONTHLY

MECHANICS AND HANDICRAFT

Can "Death Sand" Win Battles?

PAGE 144

25¢ February, 1951

Wilbur Shaw Drives 1951 Plymouth

"Your Dream HOME-

8 Beautiful Plans

4 With Material Costs Under $3500

also 4 More Spacious Homes Requiring More Material

*Based on Estimates Secured Last Year in the Midwest and on the East and West Coasts.

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terials for Basic House Including Fi
Dormers Cost Less than $3500. Famous "
that-Grows" Plans Show How
ish Attic, Add Breezeway an
rage for Nominal Cost Late

AMATEURS Saving Thousands of Dol

SAVED $5500! Young D. A. D. built his own home near Washington, D. C., with help of "YOUR DREAM HOME"—and saved $5500! Four of D's co-workers also built homes worth up to ONE-HALF more than they spent.— *Pathfinder, Sept. 5, 1950.*

NET COST $4500! R. H. S., New Bern, N. C., who built from "YOUR DREAM HOME," writes, "My home is complete and I live in it today. Net cost $4500."

Amateur Building Sweeps the Land! Coronet desc "$15,000 Home for Only $6000!" Ladies' Home Jo reports $18,000 home for only $9089, built with Bild Patterns! American Home tells of $5000 stre to "$15,000 Worth of House"! Better Homes & Ga survey shows less than half of the homes being by contractors. Yes, by the thousands, amateurs SAVING countless thousands of dollars!

SAVED $4000!, w "DREAM HOME" i D. M. L., Lexington Md. "Though inex enced, we easily s $4000. Anyone con ing building a should have your exc book."

SAVING $5000! E New York City, or two copies of "Y DREAM HOME" one writes, "Will put to good use. In bul our own home, we sh save at least $400 $5000."

576 Big Double-Column Pages—650 "How-to-Do-It" Pictures!

HERE'S A MERE HINT OF THE HUNDREDS OF PRACTICAL "SHOW-HOW" FEATURES!

Selecting the Locality and Site
Choosing Proper Elevation; Drainage Sun Light; Solar Heating, etc.

Complete Material Lists
Each of the 8 House Plans Includes Complete Material Lists of Lumber, Masonry, Hardware, Plumbing, Insulation, Wiring, Heating Equipment, etc., so your supply dealer can quote exact total cost

Masonry and Frame Construction

Clearing the Land
Positioning House to Make Most of Lot
Clearing Trees, Rocks

How to Make The Foundations
How to Mix Concrete
Pouring Cement Foundation
Cement-Block Foundation
Waterproofing

How to Build Frame
Setting House
Girder or Lintel
Foundation Sills

Any amateur can do a beautiful wall tiling job with new plastic and metal tiles!

Nailing Wall Studs to Floor Joists
Framing the Walls

How to Sheathe the Frame
Two Days Work — Sheathing House with these Easy Tips

How to Insulate
How to Apply Blanket, Batt, Fill and Board-Type Insulations

How to Build Storage Walls

Building the Roof
Types of Roof
How to Erect the Rafters
Laying Roof Boards
Metal Flashing
Erecting Chimney
Shingling the Roof
Roof Cornice, etc.

How to Build the Inside Partitions
Making Livable Rooms
Plywood, Composition Wallboard, Plaster
Novel Effects Possible With Glass Blocks
Constructing Stairs

How to Set In Windows and Doors
Doors and Windows from Which to Choose
How to Hang Doors

How to Install Plumbing System
How and When Every Pipe and Fitting Goes in—You Can't Go Wrong
Locating Tub, Sink, Water Closet, Bidet
How to Lay Sewer Pipes
Installing Gas Pipes
—And Much More!

How to Install Electrical System
How to Wire Each Room
Outside Lighting

LUMBER PRICES GOING DOWN!
The Wall Street Journal reports wholesale prices of West Coast fir 2 x 4's (used for framing houses) down $10 to $20, and 1" x 6" No. 2 pine boards down $5 to $6 a thousand feet. Dealers see further 33⅓% drop in early 1951.

Stapling roll-insulation between wall studs is fast and easy!

How to Join Wires, Connect Fixtures and Outlets, etc.

How to Install Heating System
Installing Warm-Air Heating
Insulation Precautions
Other Types of Heating — Solar, Radiant, Steam, Hot Water

How to Apply Interior Finish
Quick, Easy and Satisfactory Wall and Ceiling Finish
Making Plaster Arch
Laying Finished Floor
Interior Trim, etc.

How to Apply Exterior Siding
Comparison of Brick, Stone, Shingle, Stucco, Clapboard, Aluminum and Other Sidings

Building a Modern Kitchen and Bath
How to Build Your Own Modern Cabinets
How to Apply Linoleum or Asphalt Tile
Bathroom Walls
How to Install Every

Save thousands on kitchens, baths, closets—even a new apartment

Kitchen and Bath ture, etc.

Building a Fire Painting, Decor
Outside and I Painting
Painting Interior
Complete Wallp ing Instructions

How to Mak Built-In Furnit
Alcoves, Dine Kitchen Cabinets, ity Tables, Ward and-Chest Storage etc.

How to Build Garage & Brea

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How to Build it for LESS THAN $3500!"*

(Enlarge and Modernize Your Present Home at Thousands of Dollars Savings!)

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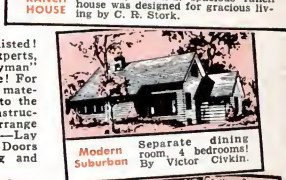
SAVE up to $8,000!



RANCH HOUSE This easy-to-build, spacious ranch house was designed for gracious living by C. R. Stork.

THOUSANDS are doing it—so can you! With the aid of this easy-to-follow, step-by-step wonder book, you can build YOURSELF the home of your dreams—any one of 8 beautiful homes! Yes, you and your family can build and own a home far more spacious, beautiful and comfortable than you ever dreamed of—a home you will always be proud of and your neighbors will envy!

Save up to $8,000! It's common knowledge that, of every $100 you spend for a commercially-built house, only about $30 goes for materials. Now this amazing volume shows you how to SAVE most of that big $70 difference—*by building your dream home yourself!*

Complete building plans and simple, easy-to-follow instructions offer you a choice of 8 grand, spacious homes—sure to delight your taste and purse! Over 650 show-how pictures clearly explain EVERY step, from selecting the site and starting foundation to final landscaping. Complete material costs as low as $1,500! Savings for you up to $8,000 on a lovely house worth $16,000.

Own a $10,000 Home for Material Costs as Low as $2,717!

Think of it! No longer need price tags of $9,000 to $25,000 and more stand between your family and the home of your dreams. YOU can build a showplace home and save 50c on every dollar! SAVE up to $8,000!

Or perhaps you want that family Vacation Home in the mountains, lake or seashore. Actual East Coast material costs estimate on this comfortable home came to only $1,495!

Fully illustrated, all materials listed! Prepared by outstanding building experts, headed by Hubbard Cobb, "Handyman" of national radio and newspaper fame! For each of 8 houses, you get complete material lists of EVERYTHING down to the last nail—clear, easy-to-follow instructions on EVERYTHING—How to Arrange Financing—Select Site—Clear Land—Lay Foundations—right along to Roof, Doors and Windows, Insulation, finishing and decorating Cellar to Attic.

Let Your Building Supply or Lumber Dealer Help You SAVE MORE!

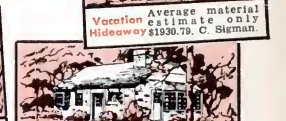
Consult your local lumber and materials dealer. He's a good man to know. Take complete materials list on your Dream Home to him. He will give you exact up-to-date costs, show you additional savings possible by using local materials, aid you in financing and help you all along the way.

And remember Government Regulation X—while slowing contractor-building, especially on homes over $20,000—actually works in your favor. Already it has brought lumber and other material prices down. On a $5,000 house it permits a loan of $4,500; on a $9,000 house a loan up to $7,100. Such loans would cover your material costs more than twice over. So plan your Dream Home now and SAVE MORE!

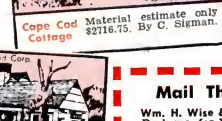
Modern Suburban Separate dining room, 4 bedrooms! By Victor Civkin.

Courtesy Portland Cement Ass'n.

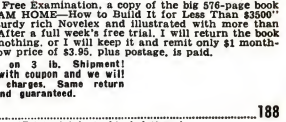
Colonial Home Build this home at possible savings of $5000. By T. Johnson.



Vacation Hideaway Average material estimate only $1930.79. C. Sigman.



Cape Cod Cottage Material estimate only $2716.75. By C. Sigman.



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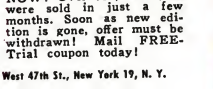

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Cotswold Cottage Delightful cottage for some proud housewife.

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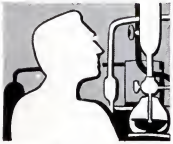

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How to Buy a Good Used Station Wagon

WILLIAM J. CANELL is one of the leading reconditioners of station-wagon bodies in the New York City area. Next month he will tell POPULAR SCIENCE readers what he has learned about caring for such bodies—and how to spot a good one on the used-car market.

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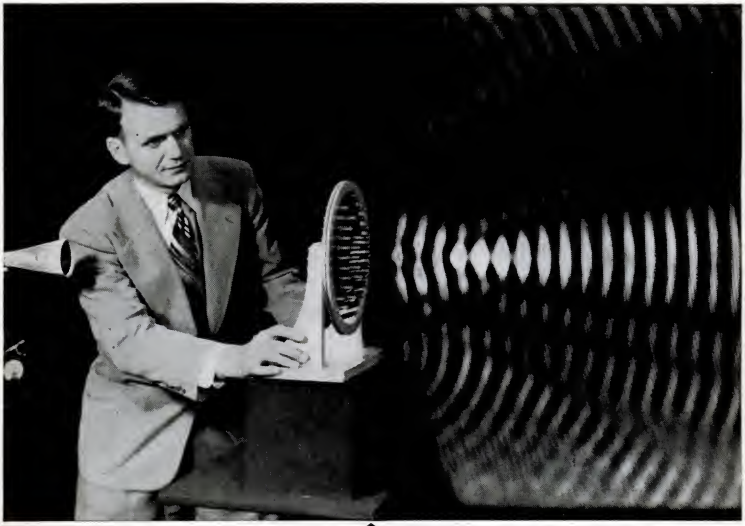

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Waves from the sound source at left are focused by the lens at center. In front of the lens, a moving arm (not shown) scans the wave field with a tiny microphone and neon lamp. The microphone picks up sound energy and sends it through amplifiers to the lamp. The lamp glows brightly where sound level is high, dims where it is low. This new technique pictures accurately the focusing effect of the lens. Similar lenses efficiently focus microwaves in radio relay transmission.

At Bell Telephone Laboratories, radio scientists devised their latest microwave lens by copying the molecular action of optical lenses in focusing light. The result was a radically new type of lens—the array of metal strips shown in the illustration. Giant metal strip lenses are used in the new microwave link for telephone and television between New York and Chicago.

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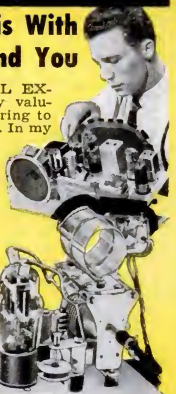

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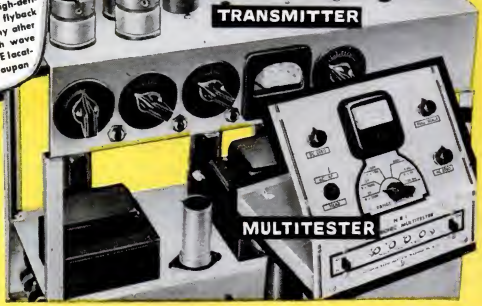

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Television is TODAY'S Good Job Maker

In 1946 only 6,000 TV sets sold. In 1950 over 5,000,000. By 1954, 25,000,000 TV sets will be in use, according to estimates. Over 100 TV Stations are operating in 35 states. Authorities predict there will be 1,000 TV Stations. This means new jobs, more jobs, good pay for qualified men.

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Letters

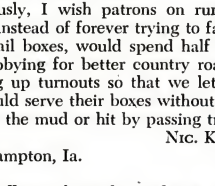
Flagged Down

Sir:

As a rural mail carrier, I have a boner to pick with your mostly excellent magazine. That's your suggestion under "Keeping the Home Shipshape" in November, page 170, for making a mailbox flag automatic.

Your scheme is against Post Office Dept. regulations, under which the signal flag is supposed to be in lowered position except when the patron has placed mail in the box for the carrier to collect. The carrier puts it down when he picks up the mail—whether or not he delivers any.

Your doctored-up flag, working backwards, would cause us carriers a lot of trouble, since it would indicate there was mail in the box to be collected when actu-



ally the patron had only failed to pick up the mail we'd left the day before. Now if you could figure out a flag that would go *down* automatically after the patron had set it up, then you would really earn the thanks of all rural carriers!

Seriously, I wish patrons on rural mail routes, instead of forever trying to fancy up their mail boxes, would spend half the energy lobbying for better country roads and in fixing up turnouts so that we letter carriers could serve their boxes without getting stuck in the mud or hit by passing traffic.

NIC. KLEIN

New Hampton, Ia.

Officially, you're right in objecting to our mailbox suggestion. Says Joseph J. Lawler, Assistant Postmaster General, in a letter to PS:

"The Postal Regulations provide that rural carriers shall open and examine mailboxes of patrons only when signals are displayed to indicate that the boxes contain mail for dispatch. When the mail is collected from the box, the carrier shall lower

INVENTORS

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the signal, regardless of whether he has deposited mail in the box. The carrier shall not raise the signal on a box at any time."

Practice, however, varies with communities. Several rural-route patrons have told us that both they and their carrier customarily use the mailbox flag to signal each other to pick up mail.

Safety Suggestions

Sir:

I have two suggestions that might avert railroad disasters like that which occurred in the collision of two commuter trains in New York on Nov. 22:

1. Have two red lights on the rear coach that blink alternately when the train is moving less than 20 m.p.h. and at all times when it is stopped on a main track.

2. Install in the cab of each locomotive a radio or radar device that would flicker a light and sound a warning as soon as the engine came within one mile of a train ahead.

HERBERT W. TERWILLIGER

Oil City, Pa.

Shock Treatment

Sir:

Here's the simplest way I've found to avoid those shocks from static electricity generated by friction of clothing on plastic seat covers when sliding into a car [PS, Dec., p. 12]:

Avoid touching any metallic part of the car until seated. Then ground yourself without shock by touching a key or a coin—or a ring, if you're wearing one—to the ignition switch, door handle, or other metallic part of the car.

EDWIN WIEGAND

San Bernardino, Calif.

Tooling vs. Carving

Sir:

That article about leather working in your October magazine, page 226, confuses the arts of "leather tooling" and "leather carving."

Leather is tooled when the design is first traced on the leather, then retraced with a tooling instrument to set the design into the leather.

Leather is carved when the design is first traced on the leather, then cut into the

INVENTORS

If you believe that you have an invention, you should find out how to protect it. The first step is to have a search made of the prior pertinent U. S. patents. If a report on this search indicates that the invention appears patentable you can apply for a patent, and the specifications and claims should be prepared.

The firm of McMorrow, Berman & Davidson, with offices in Washington, D. C., is qualified to take the necessary steps for you. We can make a preliminary search on your invention, advise you whether we think it can be patented, and prepare your application for patent.

Unless you are fully familiar with the U. S. Patent Laws, we recommend that you engage the services of a Registered Patent Attorney to protect your interests. The patent laws are *your* laws. A patent gives you the right to prevent others from making, using or selling the invention claimed in your patent for a period of 17 years.

Use these patent laws for your protection. Investigate whether your invention can be patented. If you have what you believe to be an invention, we suggest that you have this firm make a search for you.

Send for a copy of our Patent Booklet entitled "How To Protect Your Invention," containing information about patent protection and patent procedure. Along with this we will also send you an "Invention Record" form, for your use in writing down and sketching details of your invention. We will mail them promptly. No obligation. They are yours for the asking.

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Registered Patent Attorneys

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Which of these 2 one time WEAKLINGS PAID only a Few Cents to become an All-Around HE-MAN at Home?

Which One Paid Hundreds Of Dollars To Train At My Side? Rex Ferris, was a skinny weakling, paid a few cents to start building into a Champion All Around He Man! Larry Campbell paid me hundreds of dollars to train at my side years ago. Start to become an All-Around He Man at home with these same secrets for only a few cents—like Rex Ferris did!

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Enjoy My "Progressive Power" Strength Secrets! Give Me 10 Easy Minutes a Day —Without Strain!

I'll teach you the "Progressive Power Method" through which I rebuilt myself from a physical wreck the doctors condemned to die at 15, to the holder of more strength records than any other living athlete or teacher! "Progressive Power" has proven its ability to build the strongest, handsomest men in the world. And I stand ready to show you on a money back basis—that no matter how flabby or puny you are, I can do the same for you right in your own home. Let me prove I can add inches to your arms, broaden your shoulders, give you a man-sized chest, powerful legs and a rock-like back—in fact, power pack your whole body so quickly it will amaze you! Yes, I'll jam you with power and confidence to master any situation—to win popularity—and to get ahead on the job! Through my proven secrets I bring to life new power in you inside and out, until YOU are fully satisfied—you are the man you want to be.

PROVE IT TO YOURSELF IN ONE NIGHT

Send only 10c for my 5 easy-to-follow, picture-packed courses now in 1 complete volume "How to Become a Muscular He-Man." Try it for one night! Experience the thrilling strength that surges through your muscles.

10 DAY TRIAL! Think of it—all 5 famous courses in one picture-packed muscle-building volume only 10c. You must actually FEEL results in ONE WEEK, or your money will be promptly refunded!

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I want thousands of new friends—regardless of cost! Get all 5 (Valued at $5.00 each) Muscle Building Courses, for only 10c. Packed with Home-To-Do-It Pictures! Start to build a body you will be proud of!

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Dear George:—Please send by return mail, prepaid, FREE Jowett's Photo Book of Strong Men, plus all 5 Muscle Building Courses. 1. Molding a Mighty Chest. 2. Molding a Mighty Arm. 3. Molding a Mighty Grip. 4. Molding a Mighty Back. 5. Molding Mighty Legs—Now all in One Volume "How to Become a Muscular He-Man." Enclosed find 10c for postage and handling. No C.O.D.'s.

Name.....Age.....

Address.....

City.....Zone & State.....

leather with a swivel knife, and the leather then decorated by means of stamping tools and a mallet.

The illustrations with your article are of carving and not, as you said, of tooling.

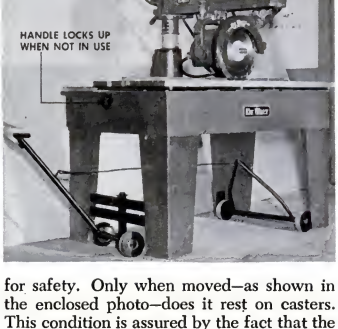
HAROLD L. POTTER

Burlingame, Calif.

Your point, though a fine one, is well taken.

Mobile Power Saw

We "mobilize" our power saw in a much simpler way than shown in your story, "Power Tools Can Ride on Retractable Casters" [Oct., p. 209]. The machine is fixed in stationary position under normal conditions,



for safety. Only when moved—as shown in the enclosed photo—does it rest on casters. This condition is assured by the fact that the handle, attached to the axle on which the wheels are mounted eccentrically, serves as a lever to lift the machine when pulled. As soon as the saw is in its new location, the handle is released and returned to its original position by the weight of the machine. When the handle then is locked up, the machine cannot be moved.

E. GEORGE STERN

Professor, Virginia Polytechnic Institute

Blacksburg, Va.

Data-Card Dilemma

Sir:

I like those file-card-size tables of shop data and materials specifications that you print from time to time "for your Popular Science information file." But I hate to cut

You receive all parts, including tubes, for building this fine, modern Superheterodyne Receiver. This and other valuable standard equipment becomes your property.

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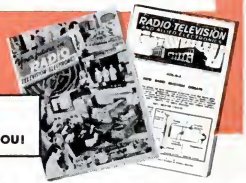

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5. How the tuning circuit functions.
6. The Radio "bands."

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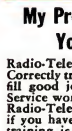
TELEVISION

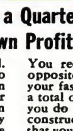


Training Leads To Good Radio Job

"Got a job in local radio shop soon after enrolling. Very satisfied with training"—Stanley Clemmons, Kansas

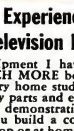
Lucky To Be Sprayberry Trained

"I consider myself lucky I chose your training in preference to others I considered. Here's thanking you again."—Paul White, Ohio



Radio Profits Pay Cost of Training

"I have more than taken in the cost of your training doing spare time radio repair work. See bright future ahead"—Thomas Shearer, N. Y.



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"While training I made about $180.00 in spare time. Thank you for wonderful Radio-TV training"—Herbert Burroughs, W. Va.

My Proved Training System—Backed by a Quarter Century of Experience—Prepares You FAST for a Good Job or Your Own Profitable Radio-Television Business!

Radio-Television is now America's greatest opportunity field. Correctly trained men are needed NOW—more than ever—to fill good jobs and handle the profitable Radio-Television Service work. I have trained hundreds of successful men for Radio-Television—and I stand ready to train YOU too—even if you have no experience or knowledge of this field. My training is modern—right up to the second—with all the newest developments included! This is 100% practical training that eliminates the frills that only waste your time and progress. Sprayberry Training provides the all-important practical knowledge and skill you need to start making money in Radio-Television in the shortest possible time. You can start at once and be earning welcome spare time cash in a few short weeks. Upon completion of my Training you will be ready to handle any practical Radio-Television job.

You receive all the equipment I have illustrated on the opposite page—and MUCH MORE besides! In addition to your fascinating Sprayberry home study lessons, I send you a total of 18 kits of quality parts and equipment with which you do over 300 practical demonstrations, experiments and construction projects. You build a complete television set that you can use in your shop or at home—you build a powerful TWO-BAND superheterodyne radio set—a multi-range test meter—signal generator and other valuable test equipment—a cathode ray oscilloscope—everything needed to set up your own Radio-Television Service Shop! All equipment I send you is yours to keep. In addition I send you many valuable service manuals, books and reference material to help you in your day-to-day Radio-Television work. I firmly believe I offer the ambitious man the most outstanding training value of its kind in America today!

Be Ready for Top Paying Radio-Television Jobs!

Radio-Television is growing with amazing speed. More than 2000 broadcasting stations PLUS an additional 102 Television stations are now on the air. Radio sets and TV receivers are being made and sold in record breaking numbers. If you enjoy working with your hands . . . if you like interesting and varied work . . . YOU BELONG IN RADIO-TELEVISION. But you MUST have good Training to "cash in" . . . the training that starts with basic fundamentals and carries through every circuit and problem of Radio-TV.

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My Training in Radio-Television is so complete, so down-to-earth that previous experience is not necessary. I start you with basic fundamentals and carry you in easy, practical steps through one Radio-Television subject after another. You will be amazed at your rapid progress and your knowledge of Radio-Television. Best of all, you put this knowledge to work making spare time cash soon after you enroll! You may train as fast or as slowly as suits your convenience. Each of my students receives individual training!

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FREE 3 Big Radio and Television Books

I want you to have ALL the facts about my complete system of Radio-Television Training! Act now! Rush the coupon for my three big Radio-Television books: "How To Make Money in Radio-Television," PLUS my new illustrated Television bulletin PLUS an actual sample Sprayberry Lesson—all FREE with my compliments. No obligation and no salesman will call on you. Send the coupon in an envelope or paste on back of post card. I will rush all three books at once!

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Please rush to me all information on your Radio-Television Training plan. I understand this does not obligate me and that no salesman will call upon me.

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☐ Are You Experienced? ☐ No Experience

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Fill cracks in chairs—
Makes loose joints firm, sands to a smooth finish!

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them out for filing, for almost always there's something printed on the other side that I also want to keep for future reference. Why not print them on a page with a picture or advertising on the back?

ARTHUR BUZY

Lackawanna, N. Y.

Many such letters as Mr. Buzy's have had the editors knuckling their heads for months. The trouble is that what one man would put on the back another man would consider useful information. Even leaving the back blank would be no solution, since it would reduce the total content of the magazine. One obvious answer, for those so inclined, is to acquire an extra copy.

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Sir:

I would like to get my shop started as soon as possible on defense work along the lines suggested in the article "Can You Help America Arm?" in your December issue, page 186.

I have a 200-amp. AC welding machine, an acetylene burning and welding outfit, a metal lathe, a bench grinder, two electric drills, a spray outfit with air compressor, a large assortment of hand tools—and several years experience in welding, lathe work, ordnance repair, and all kinds of machine work.

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HOWARD J. BALDWIN

Detroit, Oregon

The National Production Authority issues a weekly "Consolidated Synopsis of Contract Awards," listing prime contracts awarded by the Government, names and addresses of the contractors, and materials contracted for. This list is not *available to individuals by mail but may be seen by a personal visit to field offices of the Department of Commerce and such public places as banks, libraries, Chambers of Commerce.*

A small workshop operator, on examining this list, has to use his own imagination in figuring out what part of a contractor's work he might be able to produce. He must then get in touch with the contractor directly to make any proposal for a sub-contract; the Government does not enter into this negotiation.

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ABOVE: Build and keep a real 16 INCH commercial TV receiver. Optional after completing regular training at slight additional cost.

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Oscilloscope

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Multimeter

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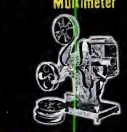

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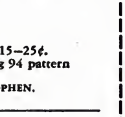
Make it with EASI-BILD patterns!

This 6 ft. bench is easy, quick, economical to build with EASI-BILD FULL-SIZE Patterns. No special tools or skills . . . trace pattern on wood, saw, assemble with CASCOPHEN. Mail coupon!



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650-16	5.96	670-15	6.26	650-20	9.96	1000-20	17.56
700-16	5.96	700-15	6.56	700-20	10.96	1100-20	17.56
750-16	6.96	710-15	6.36	32x6 (8)	10.56	1200-20	18.56
550-17	5.96	760-15	6.56	32x6 (10)	11.96	1000-20	15.56
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600-16		900-16		750-16		750-20	
Special	$6.46	Special	$9.66	Special	$9.96	Special	$10.46

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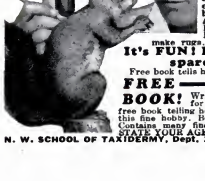

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JESSE K. KIMBALL
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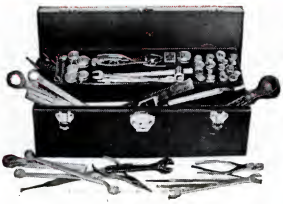

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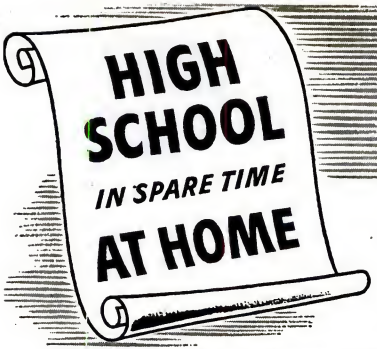

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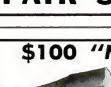

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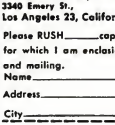

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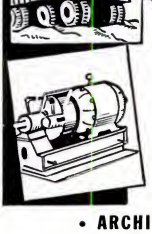

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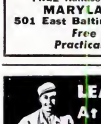

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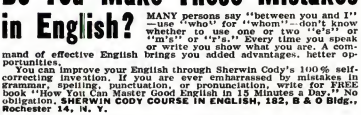

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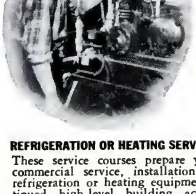

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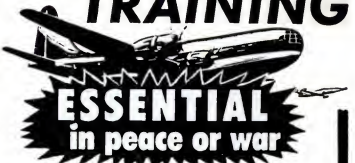

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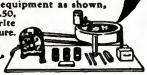

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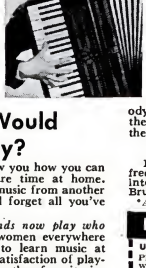

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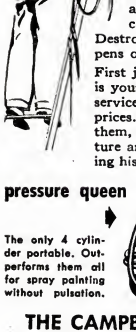

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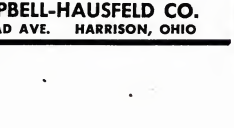

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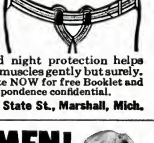

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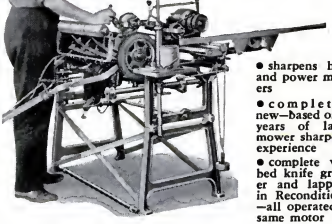

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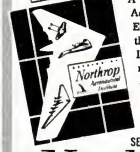

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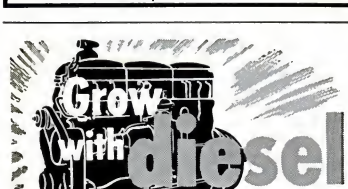

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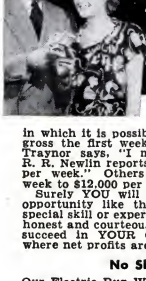

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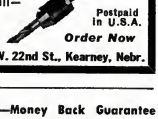

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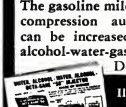

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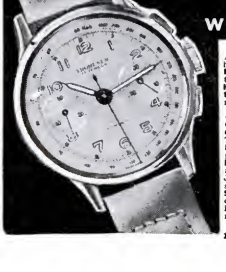

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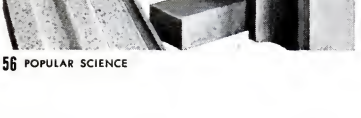

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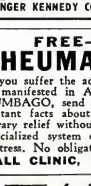

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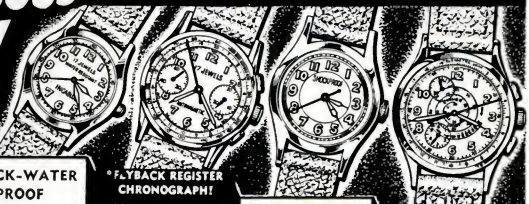

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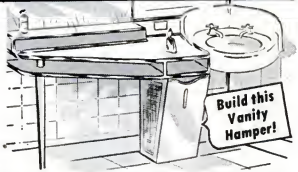

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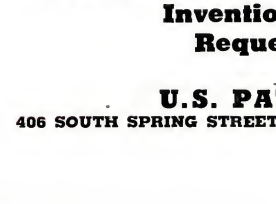

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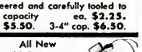

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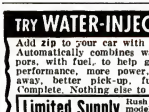

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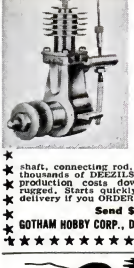

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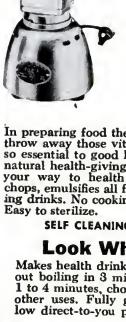

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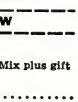

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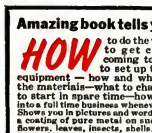

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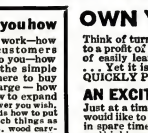

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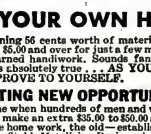

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$5 HOUR Easy! Sell name plates for houses. Free Sample, order blanks. Write: National, 214 Summer, Boston, Mass.

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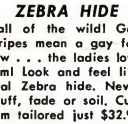

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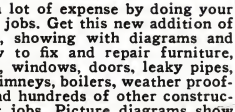

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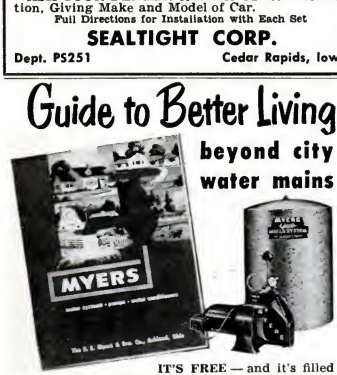

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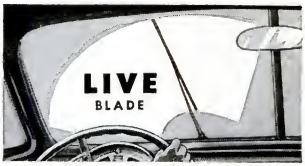

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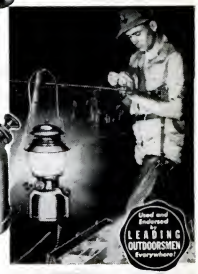
Model 200



NEW Coleman® FLOODLIGHT LANTERN

You can fish and hunt longer, have plenty of light on the trail or in camp at night with this great new all-purpose Coleman Floodlight Lantern. Superior in structure, appearance and service; more compact in design; sturdier built for hard use. Improved burner. Larger fuel fount (1½ pints) gives 8 to 10 hours lighting service. New attractive red porcelain ventilator top. Instant lighting. Floodlights 100 ft. area. Stormproof. Safe. See it lighted—ask your dealer.

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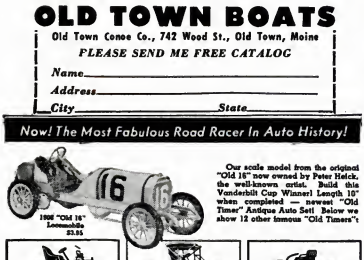

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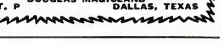

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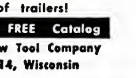

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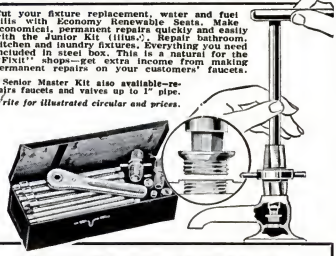

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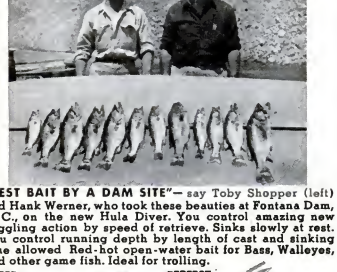

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700-16	6.57	700-15	6.57	700-20	10.97
750-16	7.77	710-15	6.37	32x6 (8)	10.57
550-17	5.97	760-15	6.57	32x6 (10)	11.97
525-18	5.57	820-15	7.07	750-20	14.57
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1000-20	18.57	1100-20	18.57
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Reg.	$11	Reg.	$11	Reg.	$10.47
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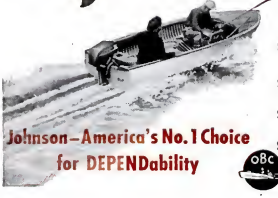

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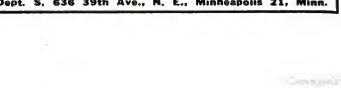

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Popular Science *Highlights* This Month

This May Be Tomorrow on Wheels: GM's startling 300-hp. test job is a crystal-ball look into what's in your car future. **Page 130**

These Are War's Dirty Tricks: And here's one being played on a South Korean mine sweeper by a Russian-type contact mine. **Page 107**

Baby Watches an Attic Grow Up: Here's how you can expand that bare upstairs into living quarters—and save many dollars. **Page 177**

Ever See a Television Camera Smoke a Cigar? One TV show really has such a talented camera—it eats pie and drinks coffee, too. **Page 106**

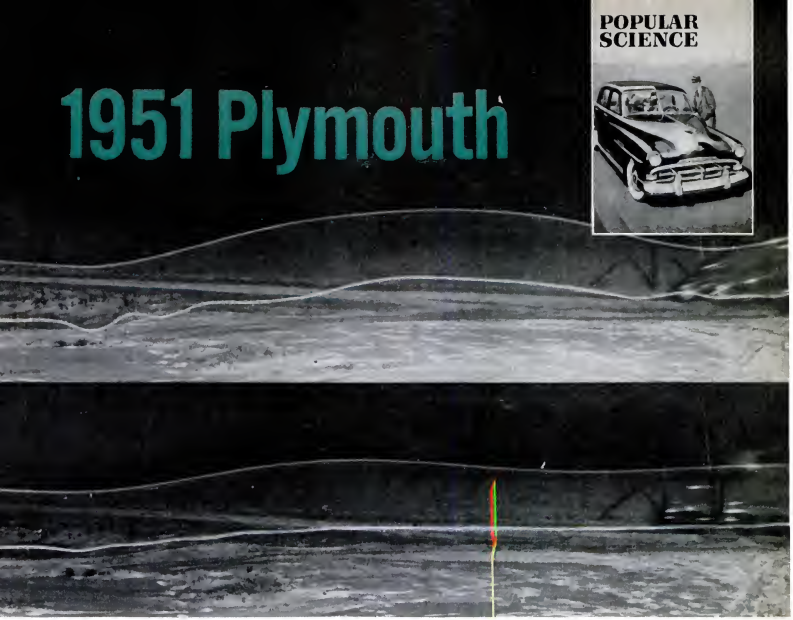
Want a Flying Saucer? Then see how easy it is to build this seagoing version that can hit 30 m.p.h. Hull cost is only $45. **Page 226**

Wilbur Shaw Drives

These light patterns, traced by a wheel and the car body, show (top) how the old-type shocks

The ditch really gave the car a bouncing, as you can see from this picture made in the daytime. When we took the pictures at night, the beams from a couple of flashlights traced on photo film the movements of both the sprung and unsprung weight. Take another look at the two panels now. The rear wheels actually left the ground with the old-type shocks.

1951 Plymouth



let a Plymouth bounce when it hit a ditch. Lower traces show pattern made by new ones.

PS's self-styled Doubting Thomas gets a surprise when he tries out a new type of shock absorber at his big Speedway.

By Wilbur Shaw

PS PHOTOS BY HUBERT LUCKETT

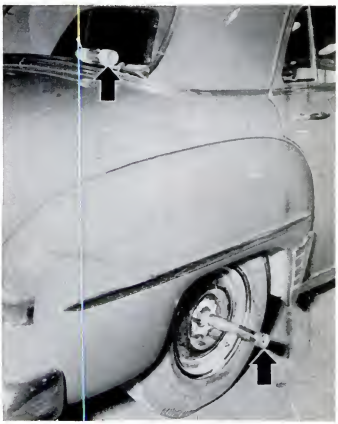
REPORT FROM THE

DRIVER'S SEAT . . .

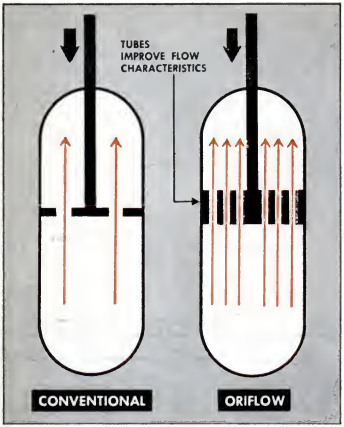
EVERY so often an automobile manufacturer puts something in a car that makes people say, "Why didn't they think of that before?" Plymouth for 1951 has done just that. This car has a new kind of shock absorbers that take most of the jounce out of bad roads.

I had my reservations about what could be done with shock absorbers when Plymouth offered to send me a spanking new car from Detroit to the Indianapolis Speedway last December. They sent not one car, by the way, but two—the second one was a '50 for comparison.

In the racing business we have experi-



Chrysler Engineering figured out how to mount two flashlights (arrows) used in tests above. All Chrysler Corp. cars have new "Oriflow" shocks.



The principle involved in the Oriflow shock absorber is shown in this diagram. When car wheels hit bumps, the fluid-filled cylinders of the shocks move up and down over stationary pistons. This forces the fluid to circulate back and forth through passages in the piston. These passages restrict the flow and damp the car's springs. In conventional shocks these passages are holes in a thin plate. It's a characteristic of such plates that their resistance to fluid flow builds up fast as fluid velocity increases—as in a hard jounce on the road. So, through a relief valve in the shock's base, the flow-resistance is compromised to take bumps averaged between mild and severe ones. In Oriflow, the passages are long and tubular. Their resistance to fluid flow builds up more gradually. So they cushion a car against both kinds of bumps.

mented with all sorts of shock absorbers. The best of them relieved the drivers of only a part of the punishment inflicted by hours of pounding driving on the race track. When a race ends a driver feels as though somebody has beaten him from head to foot with a baseball bat. In a long race the shock absorbers get so hot that they crackle if you drop a little water on them.

First let's straighten out some possible misconceptions about shock absorbers. As the Chrysler Corporation itself points out, the name shock absorber is an inaccurate description. The real shock absorber in a car is the spring. It squeezes up when a wheel hits a bump. It takes the impact.

What we know as the shock absorber could be called more truthfully a spring damper. It isn't the bump in the road that gives you a rough ride. The springs take care of the bump. It's the unflexing and flexing of the spring following the bump. The bump jounces the wheel and the wheel flies up to squeeze the spring together. That stores energy in the spring.

The energy has to go somewhere. It's taken out as the spring alternately compresses and extends itself, with shorter and shorter oscillations, until finally it stops.

The "shock absorber," so called, performs the simple function of helping damp out the spring's stored energy. It shortens the time of oscillation, bringing the spring to rest faster. The shock does this by converting the spring's energy into heat and then radiating the heat to the air.

I was from Missouri when I got behind the wheel of the new Plymouth. I know that

Facts on '51 Plymouth

So many readers have written me for additional details on the cars I try out that I am adding a fact list to each report from the driver's seat. Here's the first one:

Make and model: Plymouth four-door "Cranbrook" (formerly the Special Deluxe).

Engine: 6 cyl. L head; 97 hp. at 3,600 r.p.m.; car weight per hp., 33.8 lb.; bore and stroke, 3¼" by 4⅜"; compression ratio, 7:1; piston displacement, 217.8 cu. in.

Engine piston travel: (in feet per car mile at 20 m.p.h.)—2,140.

Crankshaft bearing surface: 34.61 sq. in.

Torque: 175 lb.-ft. at 1,200 r.p.m.

Transmission: 3-speed manual shift.

Rear-axle ratio: 3.9:1.

Steering ratio: 20.7:1.

Radius of turning circle: 39' 7".

Effective brake-lining area: 143.8 sq. in.

Springs: front, coil; rear, semi-elliptic.

Weight and outside dimensions: 3,280 lb. (est.); height, no load, 64¾"; over-all length with bumpers and guards, 193¾"; width, 73¾"; wheelbase, 118½"; front overhang, 32¾"; rear, 42¾"; tread, front, 55¾"; rear, 58 7/16".

Inside dimensions: Seat-cushion width, front 55", rear 57"; legroom, front 40¾", rear 42¾"; headroom, front 36", rear 36"; seat height, front 15", rear 15½"; vertical distance, steering wheel to seat cushion, with seat in mid-position, 5½"; front-seat adjustment, horizontal, 5"; vertical, 1⅛".

Tire size: 6.70 by 15.

in almost any shock I've ever seen the manufacturer has had to compromise on riding qualities. If a shock is set—or calibrated, as they say—for hard bumps, it doesn't do so well on little ones, and vice versa. So shocks are set at an in-between point. That gives a car owner maximum spring damping right at that in-between point and nowhere else.

To establish the comparison between the old and new shocks, I first drove the '50 Plymouth around the Speedway and then into a rough section of the infield. The track had three inches of snow on it. Here's some of the playback from my tape recorder:

The track's slippery . . . I can feel a little skittishness in my front wheels . . . but like all Plymouths, this car has good road-keeping quality and fine directional stability.

The infield, which is rough, jounced me around. I had to grip the steering wheel tight to keep my seat. There's a fairly deep drainage ditch along one of the infield roads.

"How about it?" I asked Dick Steding of Chrysler Engineering, who had come down to shepherd his cars. "Shall I try the ditch?"

He nodded.

"It's your car, remember," I warned him.

I took the ditch at 15 miles an hour.

Double Whammy in the Ditch

I wouldn't want to do this for a living. It's rough. . . . Now we'll try it at 20 . . . wham! . . . And now 25 . . . double whammy! That's too much punishment. On that last run the spring rebound almost sent me through the roof. I almost lost control.

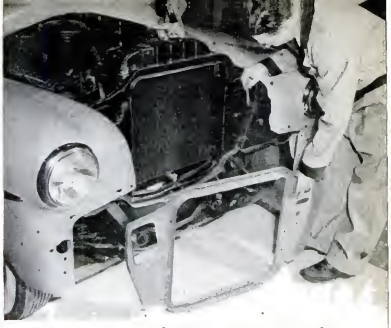
I had had enough of that. I drove back to the main grandstand section of the track where we had parked the '51 Plymouth, and changed mounts. This was a sedan, one of ten models in the line. I took another turn around the track.

The front end's restyled. A lower hood line gives you much more road visibility. There's a bigger rear window . . . the ignition switch also energizes the starter—turn the key past "on" and you're in business.

There are no drastic changes in this car from 1950. The instrument panel is like an airplane's . . . it's assembled in sections for accessibility . . . the seats are soft.

Plymouth, by the way, has coil-spring inserts for the seats to accommodate extra-heavy owners. They can be had for free.

This car has an electric windshield wiper. It replaces the vacuum type . . . the entire Chysler Corporation line now has electric wipers. The only fault I've got to find with



Let's not overlook other improvements in the '51 Plymouth. Here's another. A rigid yoke ties the entire front end of the car together for better roadability and fewer rattles.

Another thing I liked about the car was the 10-piece grille arrangement. The parts are individually replaceable. If you bang up your front end, it will cost less to get it fixed.

The instrument panel, shown here with me behind the wheel, is new too. The sectional parts detach easily for accessibility. The rear view mirror is a full two inches wider.

electric wipers is that often they don't have enough speed . . . they don't sweep the windshield often enough in a heavy rain.

I don't think the sound level is as good as in the '50. There's too much travel in the gearshift-lever action, but Plymouth always has had that fault. The brakes, though . . . nobody could find fault with them.

Or the engine. Give Plymouth credit . . . they've always made an engine—and a car, for that matter—as dependable as my grandfather's old dappled gray mare. The car's fast . . . a Plymouth won a 500-mile stock car race at Darlington, S. C. . . . The shelf above the instrument panel is glossy-finished . . . it reflects too much light.

But most of the attributes of this car are . . . I'd say this car represents, most of all, dependable transportation. . . .

People are going to wonder why Plymouth isn't offering an optional automatic transmission for '51 . . . like Ford and Chevrolet . . . I understand they decided against it because the extra cost would shove Plymouth up toward Dodge in price. . . .

It was time for me to play cowboy with the shocks. I hit the bumps on the infield.

She rides better . . . no doubt about that . . . but I still get jounce . . . I'll need some more convincing . . . one thing . . . there is little or no wheel-hop. I've always got control. . . .

For an hour or so I experimented with those spring dampers. The more I drove, the better I liked them. That was fine. But what would they do on that ditch? I squared away.

Fifteen miles an hour on the dial . . . there's . . . well, it was there . . . the ditch was there . . . something's wrong, hardly any jounce. . . . Evidently I didn't follow the tracks I made with the '50 job. I must have hit the ditch where it was shallower.

I tried it again, this time at 20. I was going through the same place, all right. I checked that.

The shocks keep saying the ditch isn't there . . . the car keeps its feet on the ground . . . there's no loss of control.

This was too good to be true. I tried the ditch again, at 35 miles an hour.

I'm releasing the wheel at the moment of impact—look, Ma, no hands! . . . she keeps her head like a lady.

"Well?" asked Dick Steding, as I dismounted.

I suppose I'm an irascible so-and-so. "I'll tell you in a minute," I said. I had to be sure.

I slipped into the seat of another make of car standing nearby and made for that ditch. Wham! The body hit the bumper blocks, and I took off on the rebound for a flight toward the roof. The wheel saved me. I turned around and braked to a stop.

"Well?" Steding repeated.

"The apologies of a Doubting Thomas to the Chrysler Corporation," I said. END

This Month's Shaw-ism

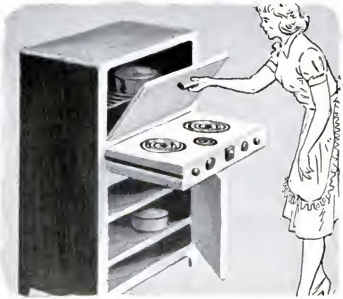
It isn't a curious coincidence that the man who treasures his car gets the best price on his trade-in.

Kilton Shaw

A comparison of the '50 and '51 cars (the '51 is on the left) will give you an idea of the changes that have been made in the front end. The wheel tread has been boosted by about a half inch in front. The span between the headlights is 54¾ inches, 3¼ inches greater.

New Ideas from the Inventors

1 Seat to Replace Sidecar. Instead of being tossed around in a conventional sidecar, the passenger on a motorcycle fitted with this side frame would ride on a seat that is astride a third wheel. This new arrangement, it is said, provides the passenger with a handhold as well as a seat and allows him to brace himself against the bumps and jolts on a rough road just as well as the driver does.



2 Stove to Save Space. Designed for use in the cramped quarters of small apartments, this compact stove has only one set of heating elements. Mounted on a drawer-like section, they can be pulled out to serve as a three-burner range for frying and cooking or they can be pushed in to provide heat for a baking oven.

3 Holders to Aid in Ironing. There should be no trouble keeping large pieces, such as sheets, off the floor when they are being ironed on a board fitted with the two fabric troughs illustrated. The trough nearest the person ironing holds damp, unironed part; ironed portion is fed into the trough on opposite side of board.

Turn the page, please, for three more new ideas.

MORE New Ideas from the Inventors

4 Ditching Gear to Save Fliers. Should the passengers of an airplane equipped with this proposed rescue device be forced to abandon the plane at sea, they would climb into a compartment, a part of the fuselage, which would be pulled free and eased down by a parachute. Inverted by a self-righting mechanism, the fuselage section and an inflated, rubberized-fabric bow would form the hull of a boat.

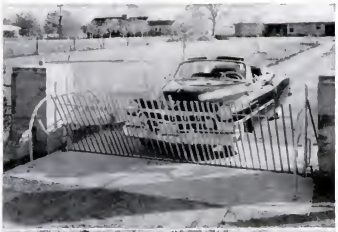
5 Heat to Soften Old Putty. The old putty around windows would be easy to soften and remove with this chemically treated strip of flammable material. Having an adhesive backing, it can be stuck to the putty. When ignited with a match, it burns slowly to provide just enough heat to soften the putty for removal.

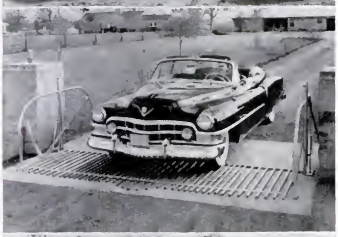
6 Luggage Rack to Fit on Car Door. When the modern car lost its running boards, it also lost the space for a running-board luggage rack, and bags that couldn't be crammed into the trunk became a problem. This door luggage carrier is designed to solve the problem. Suction cups and clamps hold it firmly in place.

Patents on these inventions have been granted to: 1. H. Ritzel, New York, N. Y.; 2. L. Ham, Selma, Ala.; 3. S. Zelzer, Calumet City, Ill.; 4. B. Townshend, Croydon, Eng.; 5. R. Martines, Cranston, R. I.; 6. W. Bishman, Minneapolis, Minn.

Recoilless Rifle on a Jeep Is Newest Tank Buster

THE Army is handing another deadly weapon to its tank hunters. It is a 105-mm. recoilless rifle mounted on a jeep. Shown above being demonstrated at Aberdeen Proving Ground, it is reported able to knock out any known foreign tank. The new rifle is a comparatively light, easy-to-handle weapon that can be operated by two men. Smaller recoilless rifles, hand-carried, are also used against tanks (PS, Oct. '50, p. 98).



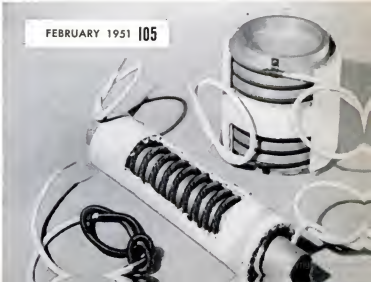


Car Works Pushover Gate

WILLIAM BENKE got tired of jumping in and out of his car to open the gate to his west Texas ranch. So he invented the automatic gate at left. The car pushes down the gate (top photo); rides over it (center); then, after hydraulic checks hold it down, it rises (bottom). Hawley Mfg. Co., Houston, makes the Push-Over Gate.

Heating Unit Wraps Around Anything

HEATING wire that can be wrapped around anything you want to keep warm is now available by the foot. Spring-steel sheathing makes it very flexible, so that it can be coiled around pipes or chemical vessels (below). Titan Manufacturing Co., Buffalo, N. Y., makes the units in several lengths, voltages, and heating ranges.



Cigar-Smoking Camera Acts in TV Show

THERE'S a camera that smokes cigars on one television show. It also drinks coffee, eats pie, stands up, and walks through doorways. For the camera plays the title role of the detective in the weekly whodunit, Dumont's "The Plainclothesman."

The neatest trick comes during the commercial, when the camera lights up one of the sponsor's Harvester cigars. This scene requires the services of three men: the cameraman, who must jockey his camera and adjust focus accurately; Kenneth Lynch (the Plainclothesman's voice and hands), who strikes the match; and an assistant, who holds the cigar and puffs through a tube.

To the audience, it looks as if the camera is smoking a cigar (below). Photo at left shows how trick is done.

Hands of the character the camera represents belong to actor Kenneth Lynch, who crouches out of view.

Suspect (really innocent) is shown badge (below). Hands are all you ever see of Lynch, who's also the voice.

Mines Are Dirty Tricks

Moored contact mines, above, are easy to sweep compared to tricky ground mine at bottom.

The sitting torpedoes are nasty, cheap, and deadly. Korea was a school for our sweepers, and a warning.

By John F. Loosbrock

AN UNDERWATER mine that costs about as much as a secondhand car can sink a million-dollar ship. And mines are made to order for a Russian-style war. They are cheap, efficient, and can be planted freely by a land-based nation with little shipping of its own to worry about.

Mine-warfare men are closemouthed about their devilish devices. In fact, mines and countermeasures are under even tighter security than submarines and anti-sub operations. Both come under the Assistant Chief of Naval Operations for Undersea Warfare, Rear Admiral Charles B. Momsen.

"Swede" Momsen, a doughty old submariner himself, wryly refers to his mine-warfare men as "the dirty-trick department."

Some of them are in the bad-dream business

of thinking up new ways to make the target trigger the bang. Others are in what is politely called "countermeasures," meaning going out in little ships and sweeping up the other guy's dirty tricks. And some of the countermeasure men are the talent scouts who catch and cut open the live enemy mines to see what makes them tick.

Mine men are trappers, and trap-snappers, rather than hunters. They seldom get a huntsman's personal satisfaction, and they collect no "hazardous duty" pay. But the men in the super-silent service have a pride in performance rivaling that of the submariners or Rangers.

Quietly and competently ferocious, mine-warfare men claim that mines have sunk more ships per dollar than any other weapon. But, so secret and unspectacular is their work, they never get enough to do the job right—in anybody's navy.

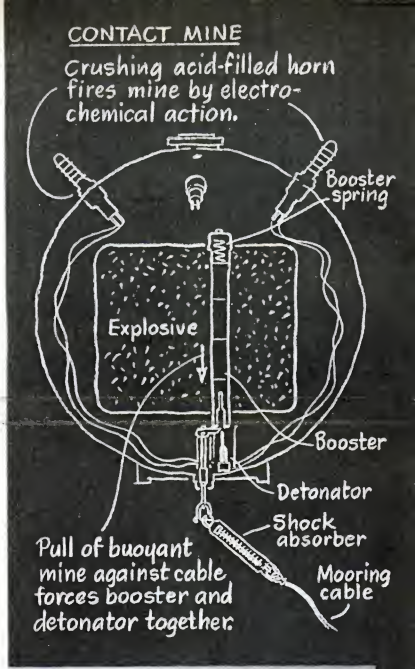
Hitler Missed a Chance

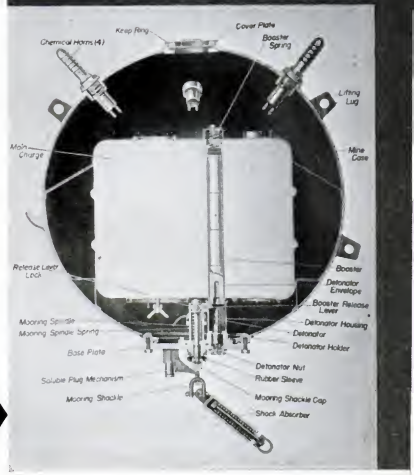
No nation in history, says Momsen, has ever used enough mines of the right kind, despite their deadly relative efficiency. Hitler could have bottled up Britain tighter than a quart of champagne if enough magnetic mines had been sown while they were still new, and very dirty, tricks. And there is the latest lesson of Korea, where Red mine fields halted a fleet for days. Five sweepers were lost, three of them U. S. Navy ships, but our mine people remark that the Reds thus provided a fine school for countermeasures. And, they add, once again there were neither enough mines nor enough variety in triggering.

"If we had faced a mixed bag of enemy mines," one Navy mine expert told me, "we could have lost a lot more ships."

By "mixed bag" he meant a calculated mixture of different kinds of mines. For mines are much more complicated mechanisms than the original *moored contact mine.* This was the Model-T kind found in numbers off Korea. It consists of a big metal ball loaded with high explosive, with an anchor to keep it at the right depth in the right place, and a number of projecting "horns" that make it go off when touched.

The catch is that it's been around for so long that the minesweepers know how to handle it. Sweeping moored mines is like

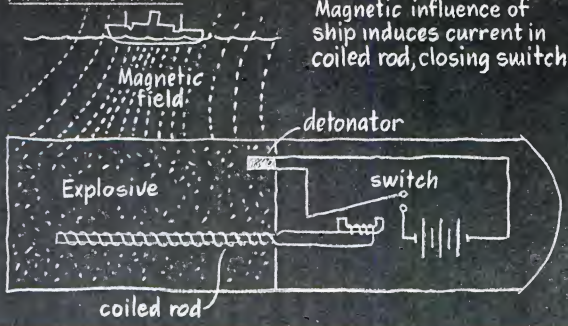




At right is a cutaway drawing of one Russian mine, a simple, moored contact type. How it works is shown in sketch above it.

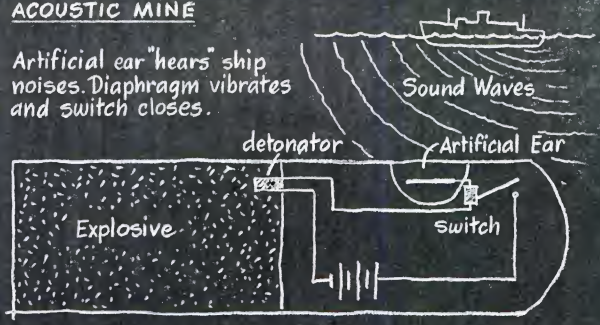
MAGNETIC MINE

Magnetic influence of ship induces current in coiled rod, closing switch.



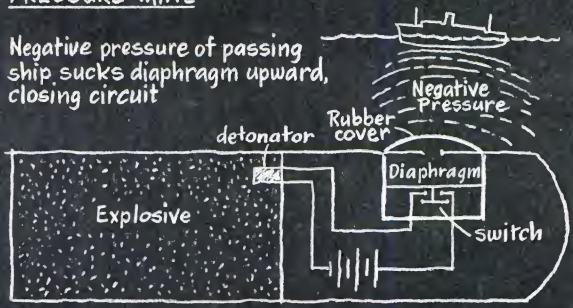
ACOUSTIC MINE

Artificial ear "hears" ship noises. Diaphragm vibrates and switch closes.



PRESSURE MINE

Negative pressure of passing ship sucks diaphragm upward, closing circuit



Airplanes like the Navy's P2V can lay ground mines in enemy waters, replenish fields as fast as swept. Parachute slows mine's fall to avoid disturbing delicate firing mechanism.

Guppy subs like this one can lay both ground and moored mines, dropping them through torpedo tubes. Russians' big sub fleet makes this kind of minelaying a grave menace.

Surface minelayers like this big job built on a cruiser hull can handle large numbers of moored mines. But they can't go into enemy waters, are largely defensive weapons.

cutting hay. Cable-cutting sweeps are dragged through suspected waters. Once the mooring cable has been snipped, the mine bobs to the surface where it can be detonated or sunk with gunfire. The sweepers move either in a wedge formation or in protective echelon, working from swept into unswept areas, like a man with a scythe.

Mine-warfare men speak a private language. They talk of mined waters as "polluted." When you put out mines you are "infesting the area." Mines can be laid by surface ships, even little ones, or submarines. But only aircraft can maintain "contamination" of enemy waters by replenishing swept areas—a surface ship or submarine dares not go back into polluted waters.

In this deadly game of poker-for-keeps, you have two hole cards—new mines that the enemy can neither detect nor neutralize; and new countermeasures that make his most prized and deadly gadgets harmless.

Thus the comparatively simple contact mine led to mines you didn't have to hit at all. You merely had to come close. These are so-called *influence* mines that lie ominously on the bottom until their particular *magnetic*, or *acoustic*, or *pressure* trigger is tripped.

Silent Sentries of the Sea

These *ground* (as opposed to moored) mines are the truly "silent sentries of the sea." Their firing systems can be scrambled into an intricate series of actions, one complementing, or booby-trapping, or backstopping another. Detection is almost impossible, and sweeping such ground mines is ticklish. There are several types:

The magnetic mine is triggered by the magnetic field of a ship. When the normal lines of force of terrestrial magnetism are distorted by a ship, the mine explodes.

The acoustic mine has an ear, a simple hydrophone, cocked for ship noises from propellers or engines. When these noises reach a certain volume, a switch closes and "Boom!"—you've had it.

The pressure mine is even more ingenious. A variation in water pressure on a sensitive diaghragm, caused by a ship overhead, closes the circuit and fires the mine.

These make tough work for the countermeasure man. Sweeping ceases to be the comparatively simple matter of cutting mooring cables. You first have to get a sample, take it apart, see what makes it tick.

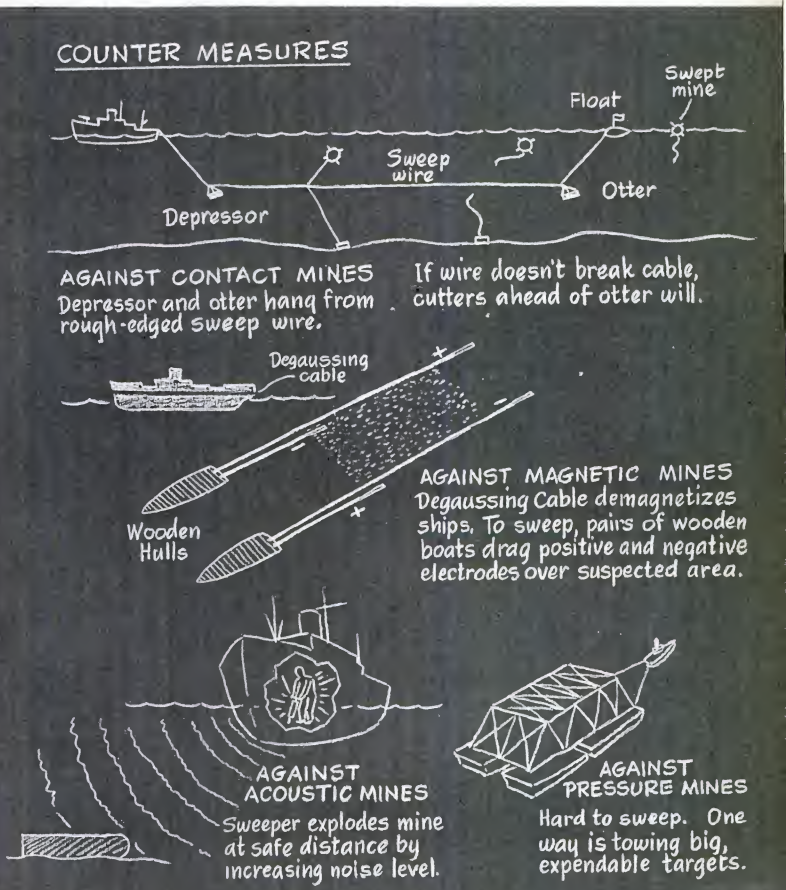
In the case of the magnetic mine, first used by the Germans in World War II, luck and Nazi stupidity combined to give the British the key. Instead of sowing them in large numbers, and letting a sinking ship give the first warning, the Germans dropped them in driblets from night-flying planes. One fell intact on a mudbank in the Thames.

That gave the British scientists who handle countermeasures their chance. An

officer went out on the beach by himself—to minimize possible casualties—took a long look and with a prayer and a guess unscrewed the activating mechanism. It didn't go off and the magnetic mine was conquered. That kind of lonely heroism is needed to neutralize and study every new type of mine.

The countermeasures were comparatively simple. Ships were "degaussed"—girdled with an electric cable that neutralized their magnetic fields. And wooden sweepers, fitted with trailing lengths of magnetic cables, were able to detonate the magnetic mines at a safe distance from their hulls.

This points up the sweeper's problem in a field of influence mines. If you can't find them, you can let them find you. So you simulate a target to set them off. Take the acoustic mine. Since noise exploded it, sweepers went out with noisemakers—in some cases they used ordinary air hammers



whanging on steel plates to fire them off.

The pressure mine is still a nuisance. In World War II, several sweeping methods were tried. Like wave making by squadrons of speedy small boats, and towing of big, expendable "targets." Sometimes a good storm will do the sweeping—exploding pressure mines by the natural motion of the sea. It saved lives off the Normandy beachhead.

But even more devilish are the imaginative variations on these three themes. Hitch an acoustic trigger to a magnetic mine. Ship noise cocks the trigger, and magnetic disturbance pulls it. A light, shallow-draft, magnetic-type sweeper, if not equipped with a noisemaker, can sweep all day through a field of such mines without making a safe path for heavy, noisy vessels.

Or reverse the order—an acoustic sweep will pass over unknowingly, leaving the mine cocked for a magnetic target. Then there are combinations comprising all three types in various orders.

Mines that Count Ships

Another tickler is the ship-counter—a speedometer-like mechanism that clicks off passing ships up to a predetermined number, then pulls the rug out. It doesn't do a convoy's morale any good to lose a ship from a mine after half the formation has passed by safely. The possibilities are endless, challenging the countermeasure men.

Mines are laid in three main ways; each has its own advantages and disadvantages:

Surface ships can carry the biggest load. But you have to use them in your own waters, and they can't replenish a field. They ordinarily lay moored mines.

The airplane is the only minelayer that can replenish a field. And it's better for surreptitious laying than a surface ship. The ground mine is made to order for it. But even aircraft can be spotted, by eye and by radar. And a plane shot down while carrying secret mines may tip your hand.

The sub is closest to the ideal minelayer. It can deposit its deadly eggs secretly, defying detection even in enemy waters. Any sub can handle mines, dropping them through its torpedo tubes.

Our own mines are cooked up by "Bu-Ord," the Navy's Bureau of Ordnance, in it Naval Ordnance Lab at White Oak, Md. To help the scientists see the problems, a large-scale "environmental" lab has been set up at NOL, where mines can be tested under actual conditions of climate and water pressure without taking them to sea.

Countermeasures are a job for "BuShips," which operates a test station at Panama City, Fla. Crews for mineplanters and sweepers are trained at the Mine Warfare School at Yorktown, Va. Here security even forbids mention of the number of graduates. Mothballed minelayers and minesweepers are going back into service. And Admiral Momsen keeps a weather eye on the whole business. He sees a big part of his job as promoting public understanding of our special vulnerability to mine warfare.

The Air Force is a valued ally in the mining job. It was the Air Force that sealed off Jap ports during the last war, and polluted inland lakes and rivers—like the very effective mining of the Danube.

Where to Strike Red Threat

The Reds' accumulation of German mine knowledge and their big submarine fleet complicate the picture, since there are only three places at which to strike:

On their doorstep.

In their area of operations.

While moving from one to the other.

You can write off the last as offering the least chance of success. With the development of improved influence mines laid by subs or aircraft, it would seem logical to knock off enemy snorks, before they can get out to do their dirty work, by countermining the entrances and exits of sub pens. Defensively we'll mine our own vital ports to keep enemy subs out. And all the while we must worry about the safety of our own surface shipping, which can be lost just as surely from a friendly mine as one laid by the enemy.

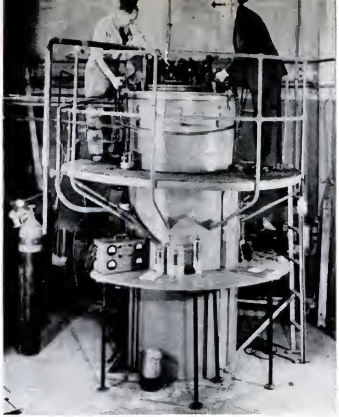
The very threat of mining has indirect effects on a nation's war effort. A few mines scattered in a sensitive area, though they might not sink a single ship, can tie up vital cargo and force constant sweeping. And mines can be used to divert convoys to areas where subs can strike more easily.

Meanwhile, our own dirty-tricks department labors mightily in its double duty:

To develop undersea weapons that can contain or limit enemy mine operations.

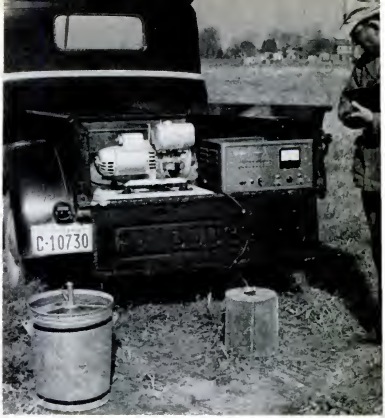
To develop the gear and know-how to detect and destroy enemy mines along our sea routes—and perhaps in our harbors.

These are tough chores about which mine-warfare men have no illusions. But if they didn't like tough chores and knotty problems, they'd be in another business. END



World's Coldest "Deep Freeze"

ENGINEERS at M.I.T. have built this cylindrical "deep freeze," believed to be the largest and coldest apparatus of its kind, to study the effects of extreme cold on materials lowered into it. The tank—called a cryostat—is 30 in. in diameter, three ft. deep. It is cooled to 452° F. below zero, only 7½° above absolute zero, by a series of five "engines" driven by compressed helium. In successive stages the gas cools by expansion, then is recompressed, cooled by a heat exchanger, and allowed to expand again. The tank has a window in its lid for watching experiments.

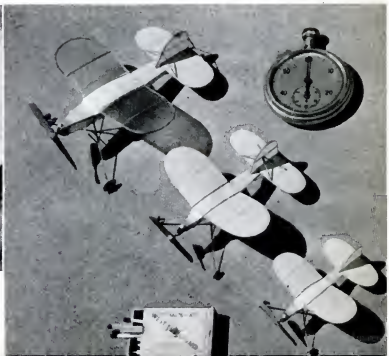


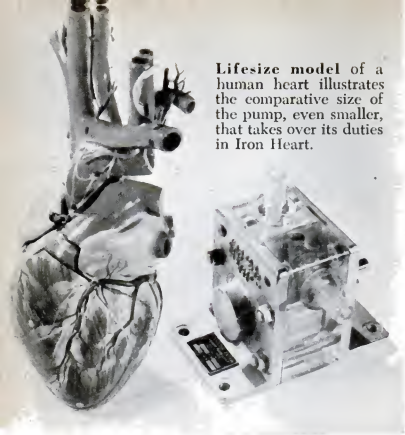
Probe Measures Moisture Underground

TO MEASURE moisture in soil, a radioactive probe, encircled by the protective cage above, is inserted in the ground. Formerly, moisture readings were taken by the slower process of digging up and analyzing soil samples. The new method, developed by Cornell University under C.A.A. sponsorship, works by measuring the scattering effect of hydrogen atoms on neutrons. It is expected to aid engineers in designing airports by enabling them to study the changes in soil moisture under the pavements of present airfield runways.

Tiny, Prop-Driven Model Plane Actually Flies

IT WOULD take over 40 of these insectlike planes to weigh even an ounce. Shown at left below as it takes off on a test flight, the 2½-inch-long miniature has a reed frame, balsa wheels and propeller, paper skin, and a wire propeller shaft. A single-strand rubber band propels it. Called the "Stubenfliege," or housefly, the plane was built by Wilhelm-Hubert Friese, of Berlin, Germany, who constructs very small propeller-driven planes. Alongside the tiny model, below at right, are other aircraft of Friese's.





Lifesize model of a human heart illustrates the comparative size of the pump, even smaller, that takes over its duties in Iron Heart.

"Iron Heart" Pinch-Hits For Real One

By taking over duties of heart and lungs, a life-saving mechanical marvel makes a doctors' dream come true.

By Paul F. Ellis

Blood gives up carbon dioxide as it drips through 200 of these layers of circular mesh.

Oxygenator, containing mesh layers in stainless-steel cylinder, takes place of human lungs. After removal of carbon dioxide, blood takes up oxygen, admitted through inlet tube at bottom.

THE "Iron Heart" has joined the "iron lung" and other mechanical substitutes for flesh-and-blood organs.

The doctors have called in the plumbers to make a pipe dream come true. The result is a machine that takes over the heart's duty of pumping blood through the body. It stands ready for an emergency at Hahnemann Hospital in Philadelphia.

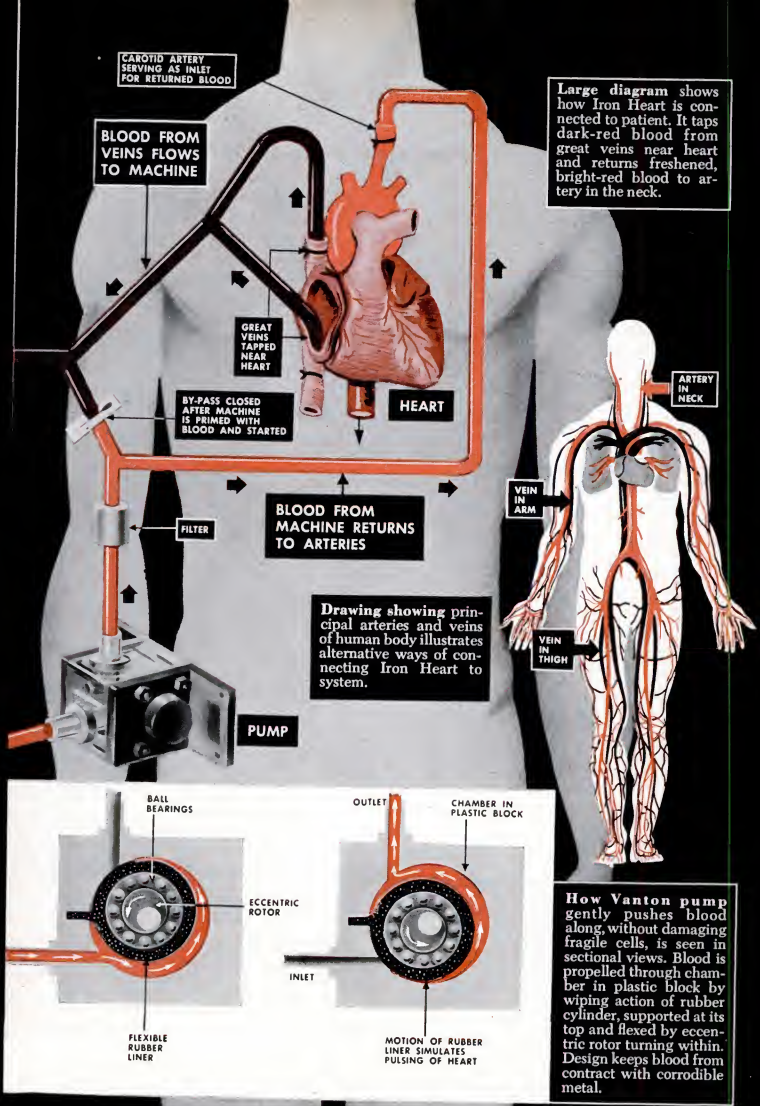
Its invention means that surgeons can now disconnect an ailing heart from the body, make the needed repairs to put it in good working order, and connect it up again. Meanwhile, the Iron Heart maintains normal circulation.

The heart is the one organ of the body that never gets a rest, aside from the brief interval between the beats of this great pump. It is no wonder that heart disease is the No. 1 killer of man.

Suppose a person's heart needs surgery to repair a flaw—say a ventricle valve that is leaking and permitting blood to flow in the wrong direction. As a result of rheumatic fever, heart damage like this is a common ailment.

There's been little the doctors could do about it—though daring surgeons have tried their best, working "in the dark" and "around corners" while the heart keeps on pumping away. They have dreamed of being able to put the heart to rest, cut it open, drain it of blood, and see what they are doing while they repair it. The Iron Heart permits them to do just that.

Its use will open fields of medicine and surgery never before explored. Quite possibly a person knocked out and apparently dead of shock in an accident can be revived with the Iron Heart. Doctors say it will be invaluable, too, in heart attacks such as angina and coronary thrombosis. Frequently, a victim of the serious heart



Large diagram shows how Iron Heart is connected to patient. It taps dark-red blood from great veins near heart and returns freshened, bright-red blood to artery in the neck.

Drawing showing principal arteries and veins of human body illustrates alternative ways of connecting Iron Heart to system.

How Vanton pump gently pushes blood along, without damaging fragile cells, is seen in sectional views. Blood is propelled through chamber in plastic block by wiping action of rubber cylinder, supported at its top and flexed by eccentric rotor turning within. Design keeps blood from contract with corrodible metal.

condition called coronary thrombosis may be kept flat on his back for as long as two months while nature heals the damage done by the thrombosis or clotting of blood. The Iron Heart would permit doctors to repair it themselves.

One of its most dramatic applications will be its first one, for which it was standing by 24 hours a day in the Philadelphia hospital as this was written. This was to be an attempt to resuscitate a patient whose heart had stopped beating during an operation, and who would be clinically "dead," after all present methods, such as heart massage, had failed. For although the doctors are certain the Iron Heart will work as well on human patients as it has on test animals, the inevitable risk of the initial trial must be justified by a dire emergency.

The Iron Heart is a compact mobile apparatus, no larger than a small console radio, housed in a transparent cabinet. It consists of two principal parts. One is a unique noncontaminating pump for circulating blood that contains no valves, gaskets, or stuffing glands. The pump is made of transparent plastic and is so designed as to cause no damage to blood cells. The other is an oxygenator, a device that supplies oxygen to blood circulating through it and simultaneously removes carbon dioxide. Blood flows in turn through oxygenator and pump, and the Iron Heart actually relieves the human lungs as well as the heart of their duties.

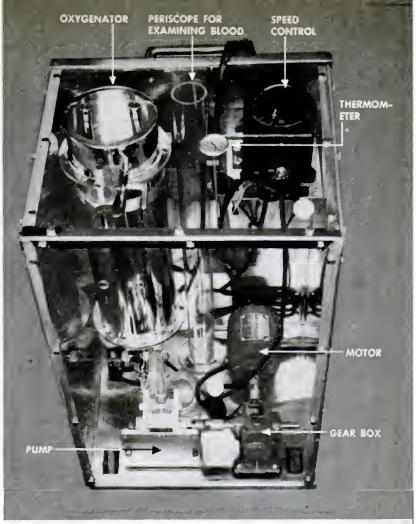
This extends the machine's usefulness to surgical cases where the lungs need to be put to rest rather than the heart. It may save the life of a patient choking to death with an asthmatic attack, or suffering from an extremely serious case of pneumonia.

How Iron Heart Is Used

To treat a patient with the Iron Heart, surgeons will open a main artery, after the machine has been primed with blood of the patient's type. A plastic tube leading from the apparatus is inserted in the artery and temporarily clamped. Another, Y-shaped tube leading to the machine is inserted in two main veins.

Then the surgeons set the Iron Heart in action. Blood is permitted to flow into the arterial system as blood from the veins travels through the oxygenator, pump, and gently back into the body. All blood is diverted from heart and lungs, except for the coronary flow that leaves the heart muscles by way of the right auricle. The heart becomes virtually a "bloodless organ." Thus a delicate operation may be completed under the most favorable conditions.

In trials on dogs, the heart continues to beat slowly but regularly. It can be stopped



Close-up view of Iron Heart in transparent cabinet, 30 inches high, reveals principal parts. Speed control serves purpose of regulating rate at which blood is mechanically pumped.

Frisky as any pup, this dog shows no ill effects from one of experimental operations in which Iron Heart kept animals alive as long as 70 minutes prior to first human test.

and started again without difficulty, while the Iron Lung is operating. The animals have been kept alive with the machine for more than an hour, and have then made complete recoveries.

The Iron Heart has the rhythm and "beat" sound of a human heart. It can circulate up to eight quarts of blood per minute, a comfortable 100 percent over normal human circulation of four quarts a minute.

For years, engineers and skilled craftsmen have been working toward such a machine. Major problems were designing a pump that would not damage the fragile cells of the blood; and an artificial lung able to remove carbon dioxide, and supply oyxgen, without forming bubbles in the blood. The chemical industry supplied the answers to both of these problems. It furnished an adaptable design in the Vanton Flex-i-Liner Pump, which gently pushes a liquid along. And a successful oxygenator or "lung" was devised by allowing blood to drip, in a cylindrical chamber, through 200 layers of stainless-steel screen mesh of a commercial type known as Stedman Packing. This exposes the blood to pure oxygen fed from the bottom of the device. The blood cells surrender their carbon dioxide to the atmosphere and absorb the oxygen. The mesh also avoids the air bubbles that could block the arterial flow—a hazard that has hindered other attempts to build artificial lungs.

Makers of the Vanton pump, J. J. Ashton & Company of New York, built the Iron Heart in a joint project with Drexel Institute of Technology and Hahnemann Medical College and Hospital in Philadelphia.

Other designs of machines for the purpose are currently under development at Yale University; at Jefferson Medical College, Philadelphia; and at Fels Institute of Antioch College, Yellow Springs, Ohio. Experimenters of the latter institution have just announced a simple, inexpensive type with enough pumping capacity for treatment of a child; future models may, like the Hahnemann Hospital machine, have the capacity required for adult patients. END

Biggest Indoor Movie Screen Made Entirely of Plastic

Now they're making movie screens entirely of plastic. These pictures show the first one being put up in New York's 6,200-seat Radio City Music Hall. It's 36 feet high by 60 feet wide—the world's biggest indoor screen—and is made of a calendered vinyl that won't crease, crack, burn, or mildew. The washable screen, made by Firestone Plastics Co., is perforated (below) with 10,000,000 tiny holes to let the sound through.

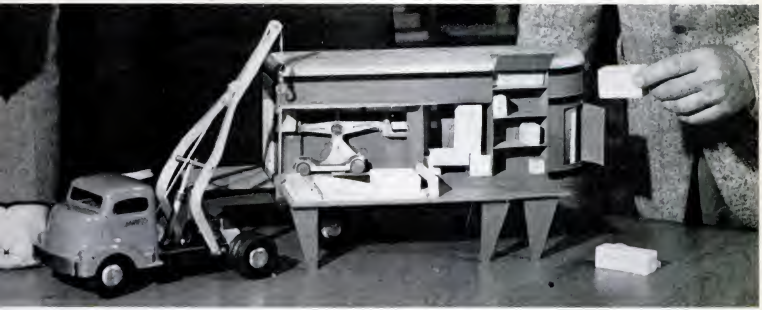
Sailing ship being tossed by angry seas against the rockbound coast above, won't be damaged much. For the breakers are only tap water and foaming chemical compound being whipped by wind from an electric fan. And the rugged rocks are wood and paper (left).

Hollywood Cuts Cost of Make-Believe Worlds

THE gadgetry and gimmickery that produce the true-to-life illusions you see on movie screens have gone on an economy budget. To cut costs while creating even more realistic make-believe worlds, eight Hollywood studios have formed the Motion Picture Research Council.

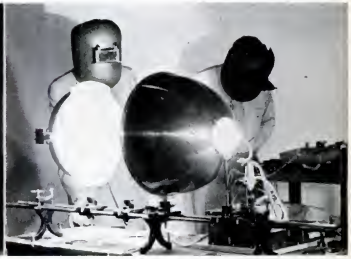
The miniature set above, depicting an impending shipwreck, made of wood and plastic, is the result of one project. In others, branches cut from trees and shrubs are "embalmed" to withstand the hot rays of studio lamps and to retain their freshness for six months; a paste enables wallpaper to be peeled off for quick scene changes.

The Council's laboratories, with nine engineers, are spending more than $100,000 a year to produce more realistic stage props with which to deceive the eyes and ears of movie-goers, streamline studio transportation, and improve photo techniques. On the opposite page are a few examples.



Equipment trailer in model form helps visualize transportation problems. Wooden blocks to scale represent equipment needed on location. Compartmentalized construction makes efficient use of space, and hinged sides permit all-around, four-way accessibility.

Front projection to provide more realistic backgrounds is still experimental. Method may save costs over conventional rear projection.



High-intensity mercury-vapor lamp for improved stage lighting is being tested by Council engineers. Unit at right is a reflector.

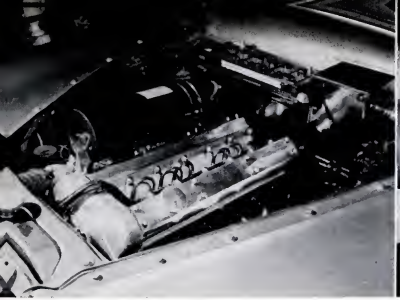
Four men try to buffet gale from new machine that can blow up a 200-mile hurricane. When throttle of its 145-hp. industrial engine is wide open, the 14-blade, six-foot prop spins 1,180 r.p.m. Blower is four times as efficient as previous wind machines.

This brand-new model of famous British Jaguar car, holder of world's stock-car speed record of more than 132 m.p.h., is being introduced in the U. S. Price: $3,875 delivered, New York.

New Jaguar Offers Luxury, Speed

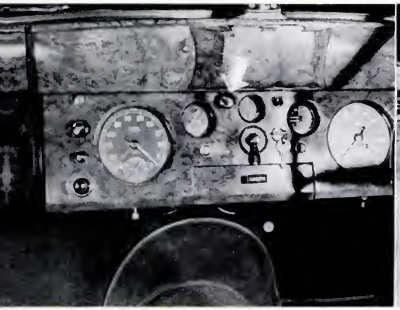
Known as the Mark VII sedan, it's full of gadgets. Long-exposure photo shows how steering wheel can be adjusted fore and aft over 4-in. range. Car is available with left-hand drive.

Sun top for fresh-air fiends is hand-adjusted panel. Car seats five; six-seater is available. Wheelbase is 120 in.; over-all length, 196½; width, 73; height, 63; and ground clearance, 7½.



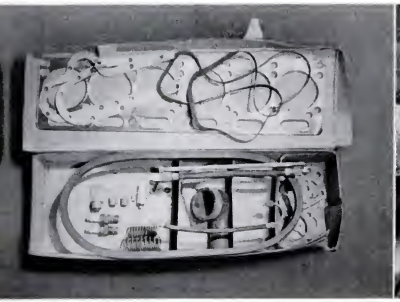
Engine is same 160-hp. six-cylinder job powering other Jaguars. It has twin overhead camshafts. Propeller shaft has two universals. Car has four forward speeds, winds up to 5,200 r.p.m.

Two airplane-type fuel tanks are located in rear fender wells. They must be filled separately. Tools in trunk are held in rattle-proof brackets. Spare tire fits in the recess at the right.



Walnut instrument panel has a tach (the large dial at left) and a fuel selector valve (arrow). Sedan weighs 3,300 lb. empty, gets 12-14 miles per gallon. Shift lever is on floor.

Here's something U. S. motormakers might well copy. Push this control and rear door can't be opened from inside. It's a safety device to keep Junior from falling out and getting hurt.



Manufacturer has thought of everything for American buyer. This "tour kit" contains everything from extra gaskets and plugs to a spare fan belt. Car's gear ratio in high is 4.27-to-1.

Full set of tools of right sizes is provided. Recessed, cushioned compartments at bottom of both front doors house open-end wrenches, still more spare plugs, other extra supplies. END

Screen in front of inspector, left, gives him X-ray view of carton of canned goods placed on roller platform, above. To help spot defects, sample film above screen shows typical faults.

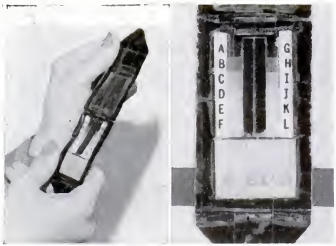
X-Ray Trailer Inspects Cans

An X-ray trailer, devised by the Army Quartermaster Corps, periodically inspects canned food in storage. Bulging or corroded cans and deteriorated contents are detected without opening a carton. Formerly, cartons selected at random were opened, and only the outsides of cans inspected.

Gas Turbines Propel Yacht

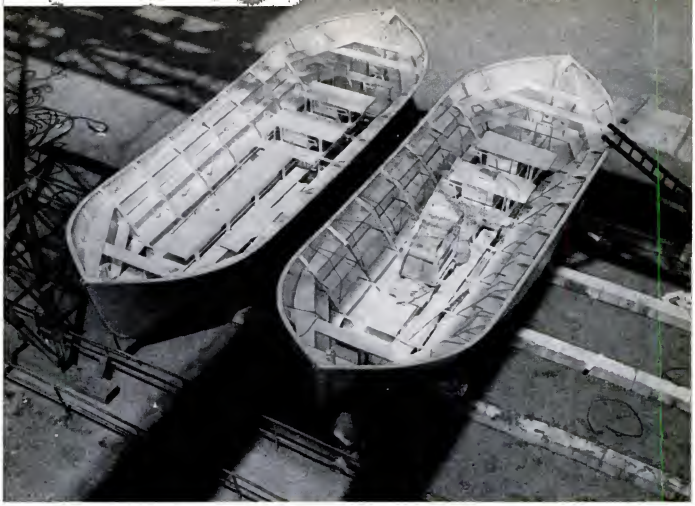
Twin gas-turbine engines, burning Diesel oil, drive the propellers of the 60-foot yacht above. The Rover Car Company, Birmingham, England, is using the craft as a floating test bed for further development of the engine (lower view), which is of the same compact design as that of the Rover gas-turbine motor car (PS, June '50, p. 98).

Self-developing film goes in locket, above; is removed and opened, and seen close-up, below.

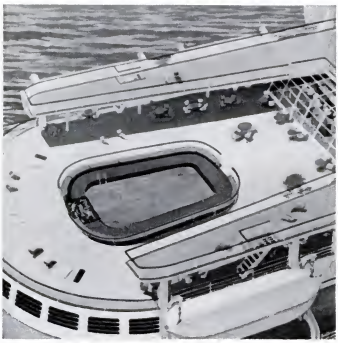


Quick A-Bomb Exposure Test

Exposure to A-bomb rays would be gauged in a jiffy by an Army film locket, worn on a chain around the neck and suited to mass production. Withdrawing the film breaks a capsule that develops it, as in a Land camera. The greater the exposure, the whiter the film strip, which is matched against a bordering scale of graduated tints.



New lifeboats resemble giant pea pods next to workman visible in center foreground, above.



Size of the lifeboats is indicated by comparison with length of swimming pool above. The *Independence* is a twin-screw, oil-burning ship of 55,000 hp., with a top speed of 25 knots.

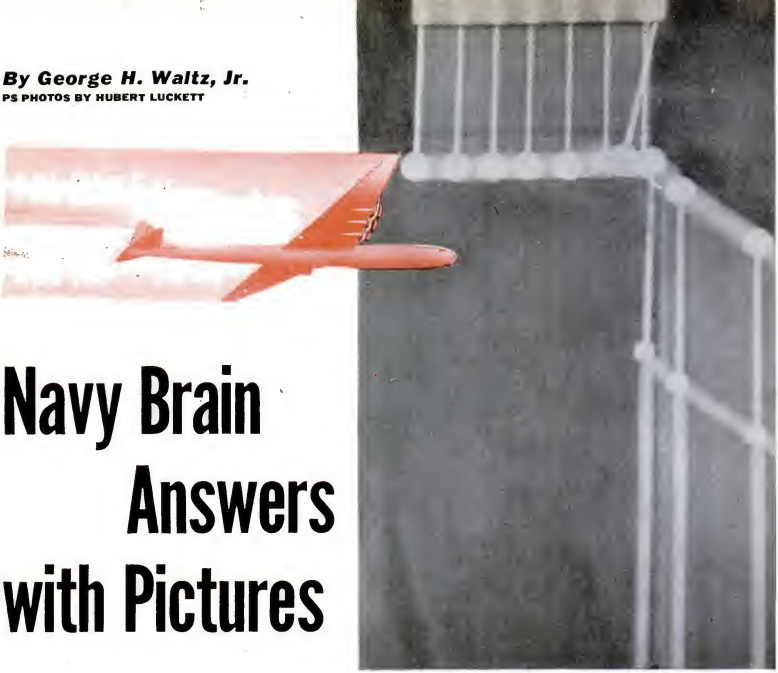
Liner Has Biggest Lifeboats

ALUMINUM lifeboats, the largest carried by any liner, are being installed on the S.S. *Independence*, a new ship scheduled to set out from New York this month on a 53-day maiden voyage to Mediterranean countries.

Weighing 6,100 lb., each of the 12 lifeboats aboard the liner has stadium-type seats. These are arranged in tiers around the sides, so that 150 persons can be accommodated. Two of the boats have radios and are motor-driven for herding the other boats together when afloat. Designed to be noncapsizable, each lifeboat has 12 watertight compartments.

The *Independence*, built by Bethlehem Steel Co., for American Export Lines, Inc., carries 1,000 passengers. It has a speed of 25 knots, and is expected to make the 4,000-mile crossing to Genoa, Italy, in 8 days. Its cruising range is 20,000 miles. All parts of the ship, including crew quarters, are air-conditioned. In an emergency, the liner can be converted to carry 5,000 troops. END

By George H. Waltz, Jr.
PS PHOTOS BY HUBERT LUCKETT



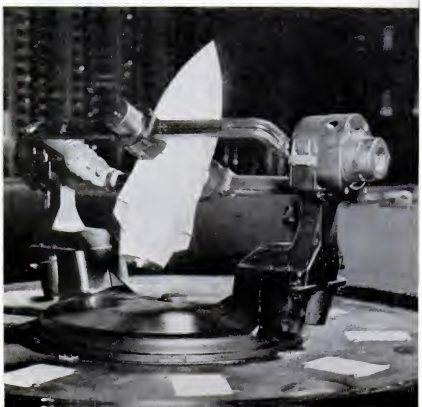
Navy Brain Answers with Pictures

COMPLEX problems can now be reduced to three-dimensional, easy-to-understand answers by "Typhoon," the latest thing in electronic brains. Built by the RCA Laboratories for the Navy Bureau of Aeronautics, the new computer is showing naval experts just how theoretical guided missiles will react in actual flight.

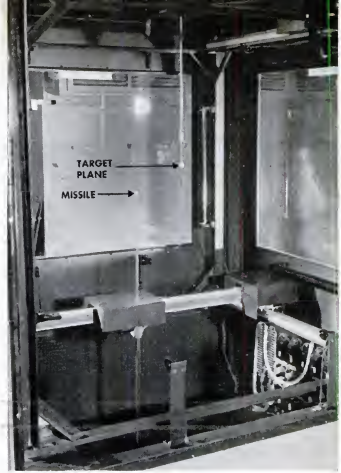
Up until the completion of the new $1,400,000 calculator a few months ago, the men whose job it is to create new and better guided missiles had to spend thousands of hours at complicated computations and many months at building full-size $100,000 test models. And when they were finished, there was no guarantee that the new missile would perform as expected.

Now, they can simply dial the design characteristics of any proposed guided-missile system into Typhoon and actually see in drawings and in three-dimensional models just how the missile will function. What's even more valuable, the design characteris-

Small-scale missile model connected to the electronic brain simulates movements of the missile at the same time that the two balls in the trajectory model (shown above at right) trace the flight paths of the target plane and the theoretical missile under test.



A hit (left) is shown in this multi-exposure photo as two balls trace plane and missile paths.



Trajectory model wired to the electronic brain gives a three-dimensional picture of the flight of the missile and the target plane it is designed to hit. Two suspended balls, lighted by ultraviolet rays so they fluoresce and can be seen in the semidarkness of the computer room, move according to instructions received from the electronic brain. In this way, the actual flight path of a theoretical guided missile can be watched and studied so that mistakes can be corrected long before missile is ever built. Computer also can be used to test airplane designs.

As the model receives the control signals, or instructions, from the computer, describing how best to hit the target plane without wasting time or fuel, its tiny control fins react as they would on actual missile and the model adjusts its position accordingly.

tics can be altered by twisting dials until the computer shows that the theoretical missile will track airplanes and score hits. And all this before a penny has been spent on costly missile construction.

Typhoon Tackles a Problem

Most electronic brains buzz out answers that are mere figures. Not Typhoon. It actually demonstrates its answers in terms that even the layman can understand. When I first saw Typhoon operate recently at the RCA Laboratories in Princeton, N. J., the brain was set up to check the accuracy of a proposed radar-guided, rocket-propelled missile with a take-off speed of 720 m.p.h. against a bomber flying 360 m.p.h. at an altitude of 25,000 feet. Previously, 100 dials had been adjusted and some 6,000 plug-in connections had been made to feed the complicated problem into the brain.

When A. W. Vance, who developed the project, touched a red master switch on

Pens on two automatic plotting boards also record the paths of target plane and missile. Board at left shows plan view while board at right shows elevation, or up-and-down view.

the long control console, the big brain went to work. As pilot lights flashed and relays clicked, two pens on each of two plotting boards—one board for the plan view, the other for elevation—began tracing out the flight paths of both the target airplane and the missile.

At the same time, two plastic balls suspended in a glass-walled booth and glowing under the illumination from ultraviolet lights, duplicated the movements of plane and missile in three dimensions. Nearby, a small-scale missile model, 12 inches long, 3½ inches in diameter, and complete with operating control fins, went through all the motions, gyrations, and spins that the actual missile—if there were one—would go through on a flight to the target. In 60 seconds, the entire flight, which ended in a direct hit, had been simulated and recorded.

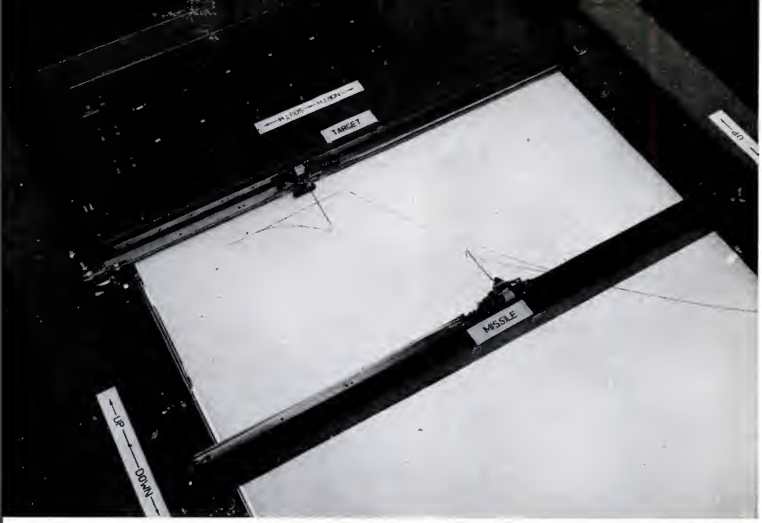
In one minute, the new computer, largest of its kind ever built, had made 250 additions, 67 multiplications, 30 integrations, and had solved 20 aerodynamic equations. All were carried on simultaneously with continuously varying factors—a chore that would have taken two mathematicians at least five years. Besides that, the brain had provided the answer in visual, understandable form as well as on records.

How would this same guided missile perform if the plane tried to avoid the missile by diving, zooming, and turning? To find out, evasive tactics were dialed into the portion of the brain that did the thinking for the plane. As I watched the two balls and the pens on the plotting boards, the theoretical "dog fight" came to life. I could see the zigzagging target plane being hunted by the guided projectile. I witnessed the actual hit.

A Check on New Theories

With Typhoon, any guided missile problem can be run through over and over again. New theories can be tried and checked. The design of a missile can be varied for each run until the desired results are obtained. Thus, by avoiding the high cost of actual trial-and-error launching tests, the new brain can inform scientists how a missile will act under any set of conditions. It can help them to remove all the possible bugs long before the design leaves the drawing board.

Most electronic brains are either analogue computers (comparable to a slide rule) or digital computers (similar to an adding machine). Typhoon, however, is a combination of both and, by blending the two techniques in more complex forms, it achieves



Plane is trying evasive tactics on flight being recorded here on the elevation board, but will be hit by missile nevertheless. Other lines show previous flight, which also ended in hit.

a flexibility and accuracy unattainable by either system alone. It is exact to better than one part in 25,000.

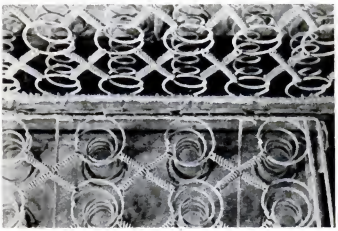
Typhoon's nerve center consists of some 4,000 electron tubes, 600 supersensitive relays, several miles of intricate wiring, and thousands of condensers, resistors, and other components. Basically, it consists of five major sections—one for the missile, one for the system for guiding the missile, one for the target plane, one for calculating the results, and one for recording those results. It takes a staff of nine engineers and mathematicians plus six technical assistants to operate and maintain the computer. Also, since it seems that an electronic brain can get a cold in the head and not operate efficiently, the room in which the computer is housed is kept at a constant temperature of 75° F. and at a relative humidity of not more than 50 percent.

When solving a problem, the various varying factors enter the brain as voltages. These are then fed in the proper order to the components set up to add, subtract, multiply, and divide in the right sequence to provide a constantly changing answer. As a result, at any moment during a solution such things as the missile's speed, yaw, pitch, roll, and fuel supply can be read from a bank of recorders. It is possible, for example, to determine the exact positions of each of the missile's control fins at any instant.

Although the new computer, after it is installed in the Naval Research Laboratories at Johnsville, Pa., will be used principally to solve guided-missile problems, its abilities are by no means limited to that one function. Fed the characteristics of a new supersonic airplane design, the brain can tell you if the plane will fly as expected, and if not, why not. It can be used to pretest the hull designs for new surface ships and submarines or the streamlined shapes of bullets, bombs, and torpedoes.

Bigger Brain May Plot Defense

And, unless its designers and users miss their guess, it will serve as a model for an even larger master calculator that will solve all the riddles connected with the successful defense of our cities and our coastlines against any possible enemy attack. The super-electronic brain they contemplate would be capable of duplicating all the possibilities of a combined land, sea, and air attack and illustrate in three dimensions the best possible methods of sure-fire defense! END



Seat Springs Stapled to Fiber Frames

THE cost of making auto cushions is cut considerably by a new method of seat construction (above) used by the L. A. Young Spring and Wire Corp. of Detroit. Coil springs are stapled to fiber panels, thus decreasing the amount of steel used by 25 percent. Flocking soundproofs the springs, eliminates burlap, and serves as rustproofing.

Safety Suit Protects Rocket Fuelmen

THE Air Force groundman above wears a new safety suit designed for protection when handling liquid rocket propellants. The new coverall is made from vinyl-impregnated Fiberglas that prevents the highly toxic fuels from being absorbed through the skin. Interior of the suit is cooled by circulating air or by water evaporation.

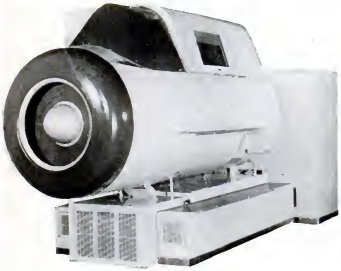
Link Trainer Now Looks Like Plane

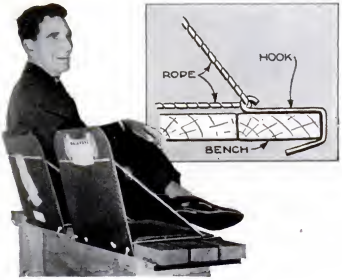
NEWEST version of the Link trainer, shown below, now looks less like a crateful of electronic gadgets and more like the plane whose operations it duplicates, the SNJ-5 basic Navy training plane. Built for the Navy Special Devices Center, the trainer now has twin cockpits, each with a full set of controls. The instructor actually "flies" with the student, and he can produce a variety of plane troubles for the student to overcome, by pushing any of 20 special-effects switches (PS, Feb. '50, p. 123).

Realistic flying conditions are presented by reproducing the noises made by a plane starting up and getting into the air. Looking through the double glass window, the pilot even sees cloud formations, rainstorms, and lightning flashes.

Back Rest Makes Bench Comfortable

WIDESPREAD use of the portable back rest below should make for fewer aching backs after long sessions on backless bleachers. Made from a sheet of Masonite Leatherwood, the back rest fastens to the bench by cords and two hooks, as shown in the inset. It is waterproof, weighs two pounds. Sold by Silas Wooton Co., Denver.





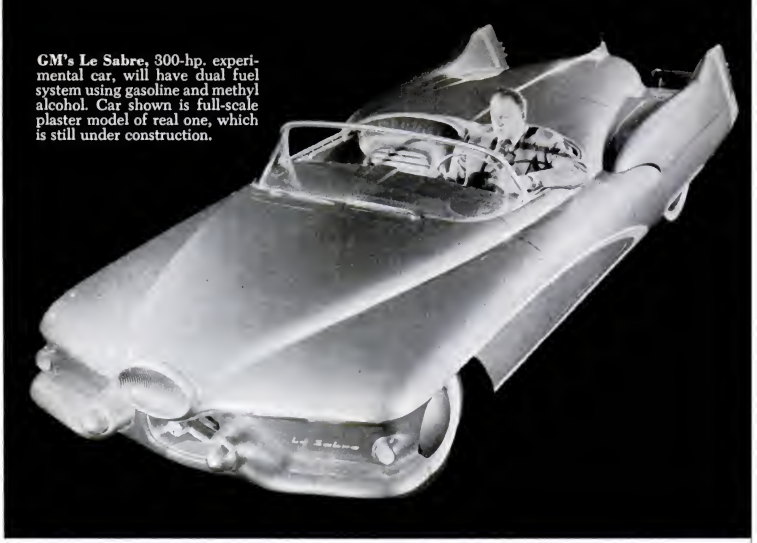
Linemen Train on Grove of Junior Phone Poles

THIS is how you learn to climb poles in the Air Force. The grove of stub poles makes an open-air classroom for future linemen at Warren Air Base in Wyoming. The poles last about a month—by then the students' spikes gouge them so badly they must be replaced.

Robot Automatically Takes Refrigerator's Temperature

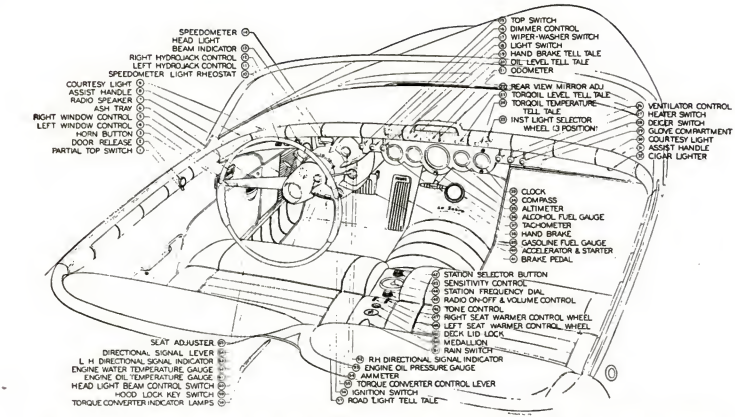
How cold *is* it inside a refrigerator? Westinghouse engineers wanted to know—without wasting all day taking the box's temperature. So they invented a machine that automatically types out the temperature at 150 different places inside the refrigerator, making 1,320 readings an hour. It can run day and night all week, or start and stop at preset times. The tabulations come out of the typewriter in sheets all ready to paste in the test book.

The robot recorder is made up of a bunch of thermocouples, a potentiometer, a cabinet full of relays, and an electric typewriter. A camshaft (in cabinet at right) connects the couples—which are scattered throughout the refrigerator (left)—one after the other to the potentiometer. At the same time, another set of switches "reads" the potentiometer indication for each couple. These switches operate solenoids that work the typewriter keys, typing the temperatures. The engineers can also use the typewriter manually to write in other information when they wish.



GM's Le Sabre, 300-hp. experimental car, will have dual fuel system using gasoline and methyl alcohol. Car shown is full-scale plaster model of real one, which is still under construction.

GM Builds 300-Hp. Preview Car



Cockpit drawing shows car's 65 different instruments and controls. Dash is crash-padded.

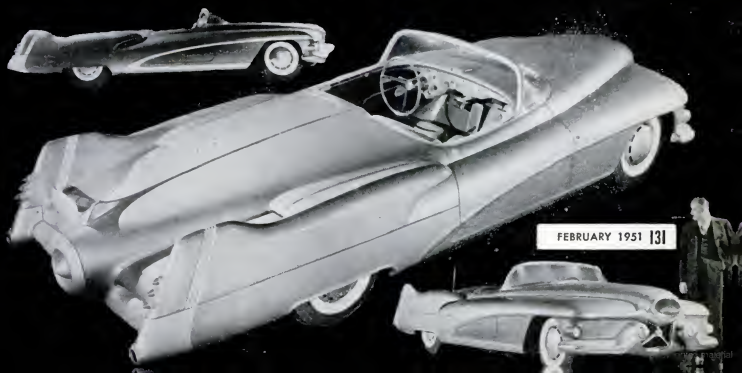
20-GALLON ALCOHOL TANK
12-VOLT BATTERY SYSTEM
ELECTRICALLY OPERATED AERIAL
HYDRAULIC JACK CONTROL
RADIO
STOP LIGHT
TAIL LIGHTS
RADIO SPEAKER
SPARE TIRE
CONVERTIBLE-TOP MECHANISM
THERMOSTATICALLY CONTROLLED ELECTRIC SEAT WARMER
BACK-UP LIGHT
VACUUM-OPERATED VENTILATOR CONTROL
20-GALLON GASOLINE TANK
TWIN AIRCRAFT JET-TYPE CARBURETORS
REAR-WHEEL BRAKES
HOOD LATCH
STATIONARY DIFFERENTIAL DRIVES INDEPENDENTLY SUSPENDED WHEELS THROUGH UNIVERSALS
TORQUE CONVERTER
TRANSMISSION HOUSING
HOOD HINGE
ONE OF TWO AIR SILENCERS
SMALL 13-IN. WHEEL
PARKING LIGHT
FINNED, TWIN-SHOE BRAKE
CONCEALED HEADLIGHTS
HYDRAULIC JACK
TWIN FANS
SUPERCHARGER

YOU can't buy this beauty, but you can expect to see many of its features turning up on cars in the years to come. Now being completed by General Motors, the hand-built, super-styled car will serve as a rolling laboratory for engineers to test out new ideas in design and equipment.

Its special high-compression (10 to 1) V-8 engine plus supercharger is expected to deliver 300 hp. Built-in hydraulic wheel jacks, electric seat warmers, and a rain-sensitive switch that will automatically put up the top are just a few of today's novelties that may become commonplace tomorrow.

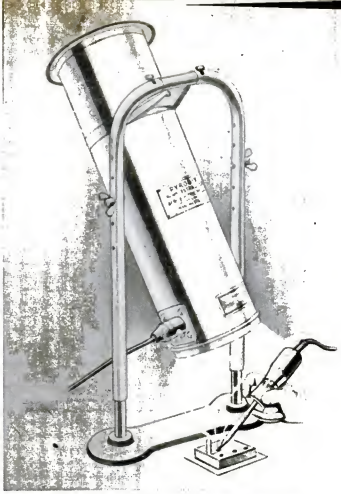
After all, an earlier 1938 GM version was the first U. S. car to boast an electric top, curved-glass windows, and push-button door latches—now taken for granted. END

Airscoop nose and twin-finned, jetlike tail show aircraft influence. Long, low silhouette is produced by 200-in. length, only 36¾-in. height. Light for its size, the car weighs 3,000 lb.



Bailout Helmet Protects Jet Pilots

THE "Man from Mars" outfit above is the Air Force's improved crash helmet for crewmen of high-speed jets. The curved Plexiglas visor, a new feature, folds upward when not in use. When pulled over the eyes, it locks into place and prevents up-rushing air currents from tearing off the helmet during a bailout and destroying a flier's essential oxygen supply. The tinted visor also serves as a sunglass.



Soldering Light Doubles as Chimney

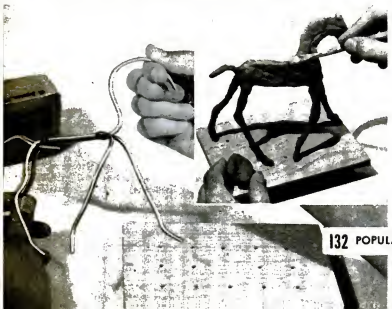
THIS unusual combination, developed by the Acru Electric Tool Manufacturing Co., of Manchester, England, is both a worklight and an exhaust hood. Set close to the soldering or brazing work, it has a strong bulb in the lower end of the chimney that provides light and also causes a convection draft that draws obnoxious fumes away from the operator. The bench mounting is adjustable and the device has no moving parts.

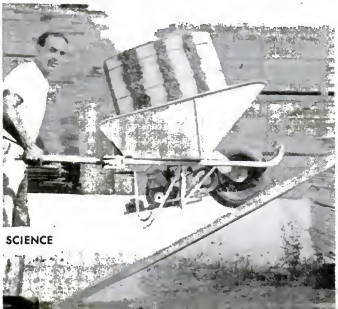
Clay-Modeling Kit Has Wire Skeleton

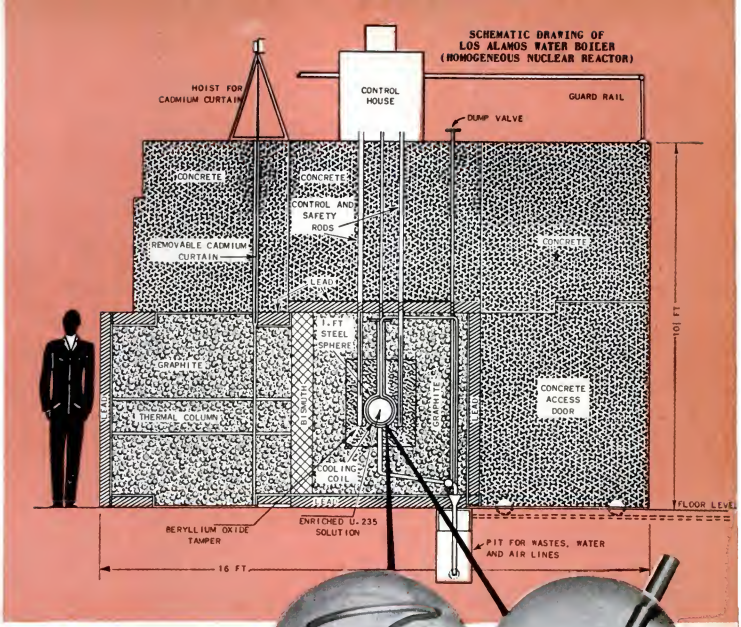
WITH this hobby kit, even a beginner can make lifelike clay figures of animals and persons, according to Sculpture House, New York City. Heart of the set is a heavy wire armature, which is bent to any desired shape or pose. Clay is then added to this skeleton in layers, and shaped with tools included in the set. Sculpkit retails for $3.95.

Powered Wheelbarrow Climbs Hills

MOUNTED underneath the wheelbarrow below is an air-cooled, single-cylinder gas engine that drives the rig at a moderate walking pace. The transmission includes a V-belt speed reduction and wheel-tread friction drive. Downhill, engine compression serves as a brake. S and S Vending Machine Co., San Jose, Calif., makes Pow-R-Barrow.







That little ball at right is an atomic furnace. Opened here, the stainless-steel sphere, 1 ft. in diameter, ordinarily is full of uranyl nitrate solution. Coil circulates cooling water. Straight pipe—called "glory hole" by Los Alamos scientists—holds material for irradiation. Drawing above shows shielding needed.

U.S. Opens Atom-Furnace Secrets

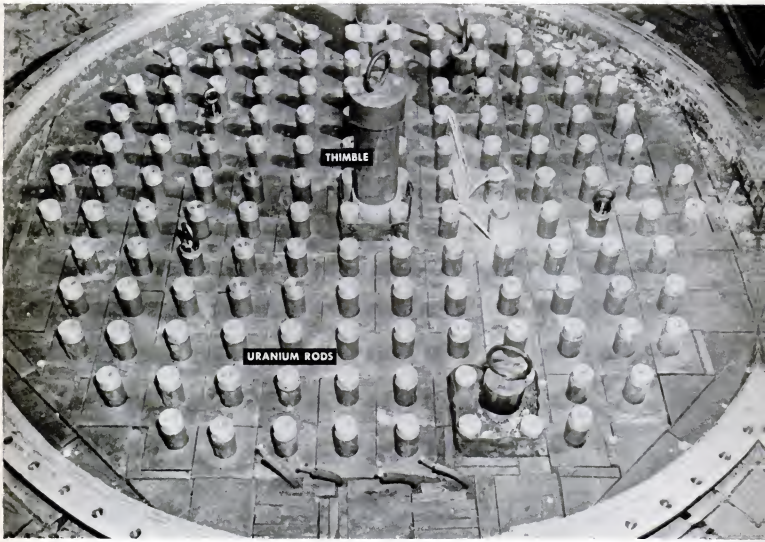
NOW you can see what an atomic furnace really looks like. The pictures on this and the following pages are the first ever to show the works of an atomic pile.

Many long-secret details are now revealed on six Anglo-American piles. One (above) is only a foot across and contains less than 14 pounds of uranium. However, this tiny ball must be encased in a concrete block 16 feet square and 10½ feet high. Another, a rebuilt version of the first pile ever made, has 100,000 pounds of uranium.

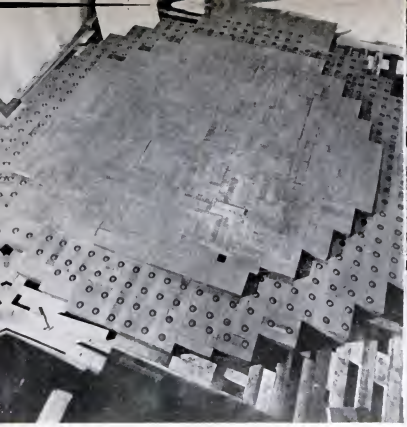
Even more significant are the scientific data also released. Things like the "thermal-neutron cross section for fission" (the probability that a neutron will split an atom)—for mixed natural uranium it's 3.9 barns (a barn is an area measurement, 10^{-24} sq. cm. per nucleus), but for pure uranium 235 it's 545 barns.

With the new information, you could build your own private atomic furnace, as North Carolina State College is now doing. But it won't help you make bombs.

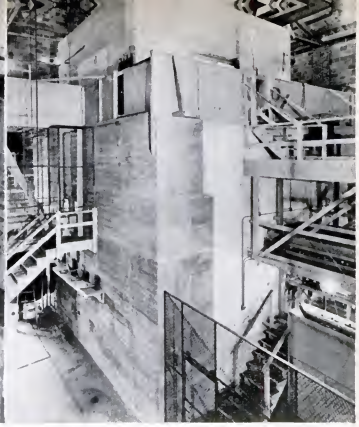
"Zeep," Canada's pile at Chalk River, Ontario, is the big smokestack-like structure above. All around it, radiating out like spokes from a wheel, are instruments using neutrons from the pile for research. Zeep produces the most concentrated beam of neutrons of any pile known.



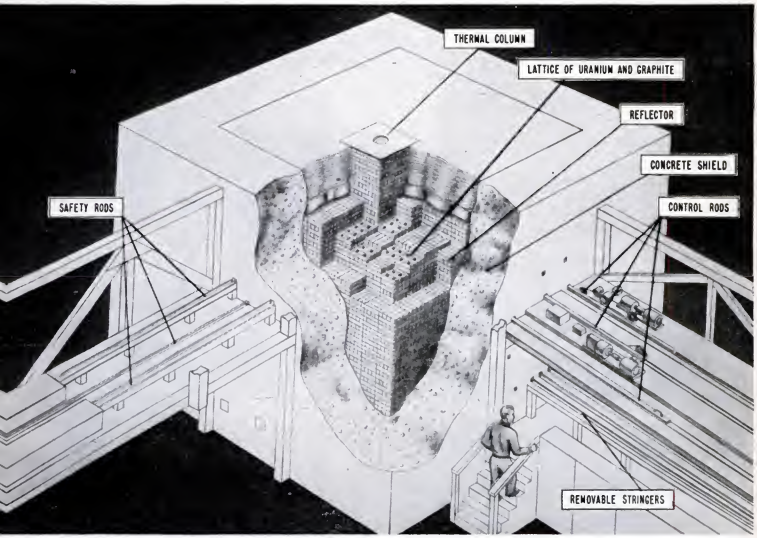
How a pile's uranium (small pipes above) is arranged—long a major secret—is shown in this photo of furnace at Argonne National Laboratory. It, like Zeep, uses heavy water instead of graphite to slow down neutrons. "Thimble" lowers materials inside pile for experiments.



Only photo made during construction of world's first atomic pile—built under University of Chicago stadium—shows 18th and 19th layers of graphite bricks. Even-numbered layers had holes for uranium, odd layers were solid graphite. This pile was torn down, rebuilt outside city



Original Chicago pile was reassembled at Argonne, using same material but slightly different arrangement. Photo above shows outside of five-foot-thick concrete shield and control-rod supports. On top of pile is small laboratory for research with neutrons generated by pile.



Present design of original pile is indicated in cutaway drawing above. "Thermal column" lets neutrons out for research purposes. "Stringers" are simply blocks of graphite that can be removed for insertion of test materials into active section deep inside the pile.

With top up, modified German Volkswagen looks like sleek sports car. It normally seats two, but two more can squeeze in behind front seat. Engine is in rear, luggage trunk in front. Wheelbase is 94½ in.

German Jeep Styled for Sports and Racing

HITLER'S Volkswagen (People's Car) has turned up in new dress. More noted for its efficiency than beauty (PS, Oct. '50, p. 162), the rugged utility car now comes in a slicked-up version that looks like a luxury sports car and doubles as a pretty fair racer—good enough to win the 1949 International Austrian Alpine race.

The transformation is the handiwork of Wolfgang Denzel, prewar Austrian speed driver. The engine is the same air-cooled, four-cylinder opposed type, but its horsepower has been boosted from 25 to 36. Some other innovations: dual carburetion, hydraulic brakes, heavier shock absorbers.

The car will hit 85 m.p.h. and gets 30 miles to the gallon. Its flashy body unbolts for easy removal—that's so you can quickly put back the conventional one when the old folks come calling or winter sets in.

As racing car, Denzel's souped-up version won 1949 International Auto Race over rugged Austrian Alps. It weighs 1,150 lb.

Cadillac Has Warning Lights on Dash

PICTURED here are three spanking new cars with fresh styling and mechanical improvements to entice the buyer.

In addition to minor changes in appearance, the Cadillac, above, has something new in the instrument group. Automatic signal lights indicate low oil pressure and generator discharge. Another warns if the car is started with the hand brake on.

That saucy rear-fender fin has been given new emphasis for 1951.

De Soto's Power Is Boosted

HERE's the new De Soto, with a bit more horsepower under the hood. The horsepower has been increased from 112 to 116. Styling treatment on this car typifies what the Chrysler Corp. has done to all the vehicles in its 1951 stable. The hood is lower, glass area larger. The wheelbase remains at 125½ inches but over-all length has been boosted 1⅞ inches to 208⅞.

Like the Plymouth (see page 98), the De Soto has a new type of shock absorber.

'51 Dodge Gives Better Vision

AND this is the Dodge for '51, with the front corner posts narrowed and the windshield widened by 2½ inches to provide better vision for the driver.

Dodge also has a glare-protected instrument panel and a better engine-cooling system. A shift-free transmission is optional on six of the ten body styles. A new internal-expanding parking brake is standard equipment on some models.

Dodge also has the new "Oriflow" shocks.

Engine Surgery Boosts Airliner Range

There's life in the piston engine yet. New turbosuperchargers and fuel injection are making spectacular gains.

By Devon Francis

THEY took an airplane engine apart the other day in a Connecticut factory, and when they put it back together again it was a whole 1,000 horsepower stronger. Yet essentially it was the same piston engine. The 1,000 horses had been gained merely by changing some of its insides.

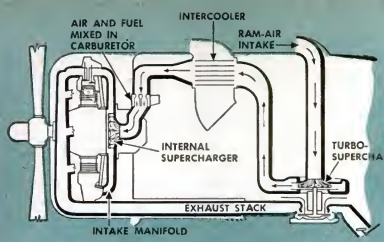
With that much added power in each of four engines, long-range commercial airplanes could fly five more tons of passengers and cargo from San Francisco to Honolulu. They could fly nonstop between London and New York, eliminating two refueling points. In fact, the changes give the piston engine a new and substantial lease on life in this day when jets and turboprops threatened them with obsolescence.

The changes centered in the supercharger. For years high-horsepower aircraft engines have been equipped with a *mechanically* whirled supercharger *inside* the engine, or with a turbosupercharger turned by exhaust gases *outside* the engine, or with both. Superchargers are necessary to high-performance aircraft engines because the cylinders need more air than the pistons can suck in. Superchargers supply that additional air by compression. They help cram more air into the cylinders on take-off; and they delay a fall-off in power as an airplane climbs higher into thinner air. In addition, an *internal* supercharger acts as a sort of sub-carburetor, ramming the mixture into all cylinders as equally as possible.

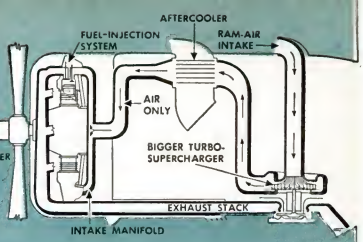
Fuel Injection Replaces Carburetor

In that Connecticut factory the designers performed a fairly simple surgical operation on an engine equipped with both an internal supercharger and a turbosupercharger. They took out the internal supercharger and the regular carburetor. They added a fuel-injection system and a bigger turbosupercharger.

That put all the responsibility for super-



Conventional engine of type diagramed above sacrifices power in two ways: internal supercharger absorbs it, and cylinders get less air because of heat generated by compression.

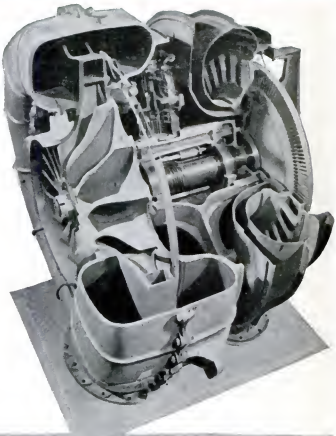


Redesigned engine gets added power from waste heat. Internal supercharger is removed, turbo size increased. Air charge to cylinders is denser because it is 250° cooler

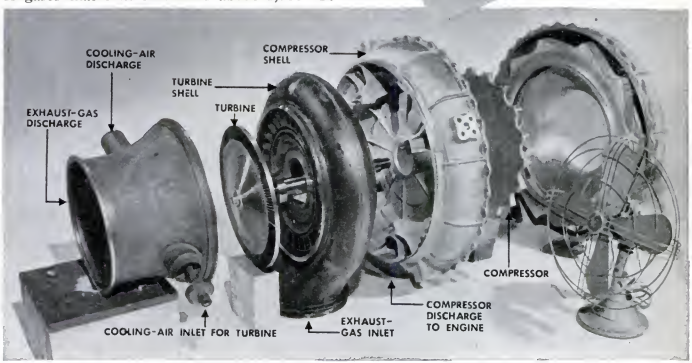
charging on the new turbo. The result is dramatic.

The turbo, developed by General Electric, can deliver 350 lb. of air per minute —so much that excess compressed air can be bled off to pressurize the passenger compartment. It boosts a Pratt & Whitney 3,250-hp. engine, used in the transoceanic Boeing Stratocruiser, to 4,250-hp. for takeoff. It reduces fuel consumption by a fifth. The saving in gasoline means 1,480 fewer gallons for four engines in winging from New York to London. That's 3½ tons—a spectacular payoff in weight alone.

Such savings can be put into longer nonstop flights or additional cargo and passengers. Neither the jet nor the gas turbine turning a propeller can touch the piston



Cutaway of typical turbosupercharger is at right; below, new turbo is shown pulled apart, with 12-in. electric fan for scale. Temperature of gases that turn turbine is about 1,700° F.



Aircraft engines have been supercharged for 30 years. Here is one of first GE turbo installations. Today's turbos turn as high as 22,000 r.p.m., deliver 5 atmospheres of pressure.

engine, with its new turbo, in economy. And while its still not nearly as fast as a jet, it's faster than it was. On flights of 1,000 miles or so, the turbos let a pilot fly 40 miles farther each hour.

Where'd this power gain come from? That involves a little background on high-performance aircraft engines. Such power plants have almost always used carburetors. This means they have also had to have internal, mechanical superchargers—which have been needed not only to compress the charge, but also to mix it thoroughly and distribute it to each cylinder as evenly as possible. Even so, the top cylinders on radial engines have tended to run lean and the bottom ones to get an over-rich mixture. Both conditions shorten the life of cylinders, valves, and spark plugs.

Internal 'Chargers Hog Power

Mechanical superchargers have brought mechanical problems, too. Speeded up by gear trains to the high r.p.m.'s necessary, they have been susceptible to a "crack-the-whip" effect during changes in engine speed. This has called for special clutches and even fluid couplings to save gear teeth from the high loads that would otherwise be imposed. It has also been accepted as a necessary evil that the mechanical supercharger is a power thief that robs an engine of the type used in the Stratocruiser of some 500 hp. It takes that much energy to turn it—energy stolen from the shaft, not from the waste exhaust gases.

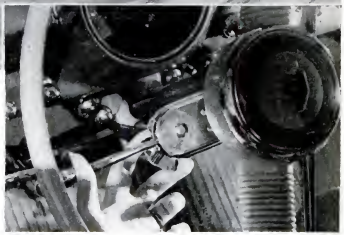
An additional problem has been heat. On a conventional engine, an "intercooler" brought down the temperature of the air after the turbo had compressed (and thereby heated) it. But that internal supercharger heated it up again by further compression. The mixture was hot when it entered the cylinders. You can't cram as much hot air as you can cold into a container. Thus superchargers have in a way partly defeated their own purpose. Another drawback to this heat has been that it encouraged detonation—"pinging." This means that compression ratios, although high, have still had to be kept below the point of maximum efficiency.

Higher Compression Possible

In the new set-up, fuel injection has removed the need for a carburetor, and for the mixing and distributing functions of the internal supercharger. It has made it possible to put the complete load of compressing air onto a turbosupercharger. With heat absorbed by an "aftercooler," air from the new turbo enters the cylinders at a much lower temperature. The engine can take higher compression, and deliver more power. Careful design has licked a past drawback of big turbos: a tendency to build up back pressure in the exhaust to the point where the exhaust valves are overheated and warp or burn.

GE is not alone in working for more power from piston engines. Wright Aeronautical, like Pratt & Whitney a major piston-engine manufacturer, has developed a "compound" engine (PS, Dec. '48, p. 128). In this one, exhaust energy drives a turbo that feeds power back to the crankshaft.

Better propellers are coming along to go with the new power plants. Experimental props, still on the secret list, are now good for 550 m.p.h. That's more speed than is claimed for the world's fastest jet transport, the British Comet. END

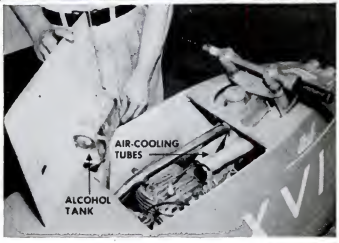


Car Lights Flash Warning Signals

FIXING a flat tire on the highway at night is a dangerous business. Here's a device that will flash your parking lights and rear stop-lights intermittently as a warning to approaching vehicles. Attached to the steering wheel as shown at right, Sigflare also can serve as a conventional directional turn signal. A pilot lamp in the lever's translucent cap lights up when the indicator is on. In most late model cars changes in lamps and sockets are not necessary. The Signal-Stat Corp. of Brooklyn makes it.

Streamlined Scooter Speeds Along at More than 83 M.P.H.

You don't have to spend a lot of money for speed—not the way Tony Capanna, of Los Angeles, does it. He took a single-cylinder scooter, made a few changes in the head and flywheel of its Powell four-cycle engine, and put on a streamlined cover. He then took his 190-lb. rig to a dry lake, stretched out prone to cut wind resistance, and opened up to hit 83.83 m.p.h. The alcohol-burning engine developed 13 hp. at 4,900 r.p.m. At upper right, wheels show through plywood housing.

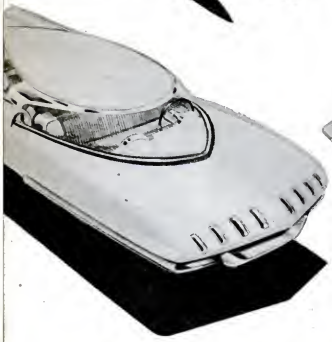


Styling department is Detroit's holy of holies. Doors are locked, guarded. Inside department is *Advanced* Styling. Only Ford officials can get in there.

The Dreams

THE automobiles you see pictured here will never be built. They are dream cars from the Advanced Styling Studio of the Ford Motor Co. The studio's artists drew them as a free exercise in imagination.

In dream car above artist was looking particularly for fresh treatment of top and door. Gil Spear, Advanced Styling supervisor, com-



Of these three cars, Artist Spear took interest only in center one. "But the hood's too broad," he commented, "even with the chrome strips to break up its expanse." However extreme, the drawings are carefully studied in hopes they will contain new ideas.

that Make the Fords

A dozen artists and four clay modelers dream up cars like this day in and day out. They have one of the world's pleasantest chores. Their only assignment is to produce new styling ideas. And they do—some 300 never-never dreamboat designs every year.

While these cars will never reach a production line, an idea for a fender curve, radiator grille, or top may be borrowed for a production car in 1955 or 1960. END

mented: "This door is low enough for a man to rest his arm on. The top has possibilities, but there is too much glass for comfort. The tail fin is impractical. But I think the idea of admitting cooling air in front through bumper apertures is interesting."

Design at left got no votes. Above, Spear confers with fellow artist over clay model. If a drawing is extra-interesting, it may be put in clay to get three-dimensional perspective.

Example of plane that could sow "death sand" is this British one for fertilizing soil from air, shown dropping five tons of lime from its built-in hoppers.

What You Should Know About "RW"

"Death sand" and "radioactive clouds" are novel atomic weapons that may be introduced in radiological warfare.

By Alden P. Armagnac

EDITOR'S NOTE: *Best defense against a possible terror weapon is knowing just what it can, and can't do. So here are the facts about "RW," latest in atomic warfare.*

UNITED STATES ARMY commanders have been alerted against an eerie new kind of atomic warfare. At any moment it may emerge from the laboratory, and make its debut in combat.

It's called "RW"—short for radiological warfare. It uses atomic weapons other than the A-bomb, such as "death sand" and "radioactive clouds."

A 12-page Department of the Army study, "Radiological Warfare," briefs commanding officers on how it may be used. Recently printed in *Officers' Call*, an official Army publication issued monthly for their information, it's the most detailed report on RW made public to date. Here are its highlights, plus some from other sources.

Name the countries that have atomic piles, and you've listed those that could wage RW—the U. S., Canada, England, France, and Russia. For any pile will furnish the needed radioactive materials, or RW agents. Just as tracers are made for research, common materials like chalk and washing soda may be put in a pile and made radioactive for use as RW agents. Also suitable are radioactive fission products, the "ashes" recovered from a pile's spent fuel rods.

The radioactive materials come from the pile both as red, white, and black powders in aluminum cans; and as bottlefuls of solutions. They are so radioactive that a large amount would melt a metal container.

Likeliest way of using these materials in war, the Army study foresees, is to sow the ground with radioactivity. They could be loosed over an enemy target from planes, in the form of a dust or liquid spray. Settling

Defenders' planes attack invaders with "death sand." It would force withdrawal of men exposed to its radioactivity, thus preventing build-up of forces to break out of beachhead.

Here are two possible types of RW weapons. "Death sand" coats ground, and its radioactivity takes effect on victims externally. It requires material emitting penetrating gamma rays.

"Radioactive clouds" of particles small enough to float in air take effect internally when inhaled. They could employ materials emitting weakly penetrating alpha or beta rays.

on the earth, an invisible radioactive film would imperil all who walked over it with penetrating gamma rays from an RW agent like radiocobalt, a radium substitute.

To spread it, Prof. Hans Thirring of Vienna proposes drying a solution of the RW agent upon sand, or metal powder. Naming the preparation "death sand," he calls it "the lightest and most transportable of all weapons of mass destruction."

Airplanes for "death-sand" attacks could resemble those used for crop dusting and spreading fertilizer from the air. A British plane for the latter purpose has dropped five tons of chemicals in a single experimental flight (PS, Jan. '51, p. 130).

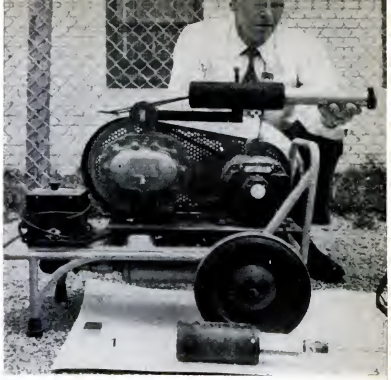
To protect occupants from the cargo's radioactivity a death-sand plane would need heavy shielding. (After calculating its weight, one scientist suggested dropping the shielding instead of the RW agent on the enemy!) But shielding could be omitted if crewless planes, under radio control from accompanying aircraft, laid the sand.

Troops in an area sprinkled with death sand will have no choice but to get out.

Standard photoflash bulb of Westinghouse SM type, below, produced "radioactive cloud" by miniature explosion of chemicals in one of experimental methods devised by Dr. Abrams.

Glass shell of bulb was removed, and experimenters applied radioactive solution to combustible charge, which forms the small black knobs seen at top of the two supporting wire elements.

These deadly products of Oak Ridge pile are potential RW agents. Remote-control tongs handle intensely radioactive solution in a pint-size bottle and a dry powder in an aluminum can.



Mobile air sampler for detecting radioactivity could warn of RW attack. Also, warning might advantageously be broadcast by attacker himself to force enemy to abandon an occupied area.

Those who remain will receive a fatal dose in anywhere from a few hours to several weeks, depending on the intensity of the radioactivity. Like victims of A-bomb radiation, they will suffer nausea, loss of hair, anemia, and hemorrhages. But those who flee at once will suffer no ill effects.

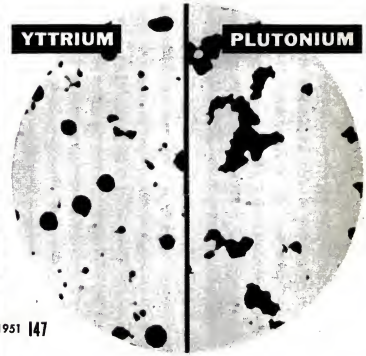
RW has novel military possibilities. An invader could be forced by a death-sand attack to withdraw exposed troops from a beachhead, for example, and prevented from building up his forces to break out of defenders' encircling lines.

In a stalemate on a battlefront, RW could compel enemy troops to abandon a key position, permitting a breakthrough. Attackers advancing rapidly across the contaminated area would not be harmed by its radioactivity. (Conversely, a radioactive belt that could be crossed swiftly would be useless defensively.)

RW attacks on war-production and transportation centers could make an enemy evacuate factories, railroad yards, ports, and adjacent living areas, without demolishing them—and, the Army study declares, "with

Igniting charge produced "radioactive cloud" of airborne particles. Actual experiment was in closed chamber. PS duplicates it, without radioactive treatment of charge, for photo below.

Electron microscope shows magnified, smoke-like particles of two kinds of experimental radioactive clouds. Size lies in most difficult range of all for gas masks to filter from air.



Can guns like this fire atomic weapons? Shells carrying RW materials may lead to the "atomic artillery" suggested as a possibility by Gen. J. Lawton Collins, U. S. Army Chief of Staff.

results comparable to strategic bombing."

Radioactivity of RW agents will die out after a time, depending on the particular one used. By choosing one of suitable half life, an attacker could make an area uninhabitable for whatever period suited his purpose—only briefly, if he expected to capture and occupy it himself.

What quantities of RW agents would be needed? An Army example assumes 430 pounds would cover an area like New York City's. Compared to the 10 pounds of pile products shipped yearly from Oak Ridge, the figure is huge, but not fantastic.

"Radioactive clouds" are a wholly different RW possibility. A low-level A-bomb burst is known to leave a deadly cloud of ray-emitting particles floating in the air. Could RW apparatus, too, create lethal airborne clouds in the open? If so, they would act as "a particularly vicious form of poison gas"—the phrase is taken from the famous Smyth Report—and serve similar purposes in close-range combat.

Casualties would result from inhaling the particles in the air. Lodging in the lungs, they would get in their lethal work at close range, and hence could emit only short-range alpha or beta rays. Some materials that do this, such as plutonium and radioactive calcium and yttrium, are among the most dangerous that can get into the body. Gas masks for protection would need filters able to strain out the particles. Otherwise the air couldn't be breathed and oxygen-fed respirators would be needed.

How to produce radioactive clouds can be described. For they've actually been made in the laboratory, in non-military and therefore non-secret experiments.

Rats were exposed to miniature radioactive clouds to explore health hazards of inhaling the particles, by Dr. Richard Abrams and his associates at the Argonne National Laboratory. Novel ways they devised to make the clouds are described in a report awaiting publication*, of which this writer has been permitted an advance view.

They contrived mechanical gadgets, resembling insect guns and perfume atomizers, that sprayed clouds of radioactive dusts and solutions. They exploded thin foil of radioactive metals, such as plutonium, with powerful electric currents. But their most interesting method was an explosion of chemicals.

The experimenters removed the glass shell from a midget photo flash bulb, and used a radioactive solution to impregnate its combustible charge, consisting of zirconium metal and potassium chlorate and perchlorate. Ignited in a closed chamber, this filled the air with floating radioactive particles, which took effect on rats nearby.

Atomic Artillery a Possibility

Can similar chemicals serve as a filling for RW shells, bombs, and rockets? Gen. J. Lawton Collins, U. S. Army Chief of Staff, recently cited the possibility of "an artillery piece that would fire an atomic weapon." Some took it that he meant shooting an A-bomb from a gun—but "atomic artillery" for RW seems more plausible.

Those are the possible arms and methods of RW. Its military value remains a big question mark until it is tried.

RW has glaring military drawbacks, like its delayed-action casualty effect. Even a lethal dose doesn't knock out radiation victims at once. At Hiroshima, several Japanese soldiers fatally exposed to A-bomb rays marched 20 miles with full packs the next day, although all were dead six weeks later. So a soldier who has "had it" from RW may still be a dangerous customer.

But RW's unique characteristics could give it a place in warfare. And it could be used especially effectively against those unaware of its limitations, as a psychological terror weapon. As the Army study puts it, "Radiological warfare, once a favorite subject for writers of science fiction, has passed into the realm of sober possibility." END

**MDDC-795, "Production and Analysis of Radioactive Aerosols," to be published in National Nuclear Energy Series, Division IV, Vol. 22G.*

Land "Tug" Runs on Tracks or Road

THE job of hauling and switching railway cars (see also page 152) will be simplified with a "land tugboat," shown above with its four retractable rubber wheels lowered for highway travel. Set at right angles are four rolled-steel railroad wheels. A switch from one to the other takes only 30 seconds.

The four-cylinder, gasoline-powered Trackmobile, developed by the Whiting Corp., Harvey, Ill., weighs only 6,000 pounds. But when the tractor is coupled to a fully loaded freight car, as at left, hydraulic jacking power lifts the coupling mechanism to transfer some of the car's weight to the Trackmobile, and greatly increases traction: drawbar pull runs up to 7,320 pounds.

Spray Comb Rids Pets of Fleas

SQUEEZING the bulb of the grooming comb at right sends a spray of insect powder through the hollow teeth, distributing it evenly through the animal's coat. Made of plastic, Comb-A-Flea is sold by Mik-Tin Specialties Co., of Seattle, for $2.

New Crosley Has Roll-Down Windows

OTHER features of the 1951 Crosley cars are a redesigned front end and, in the Super Station Wagon shown above, basket-weave rear panels. The new oversize, nine-inch Bendix brakes are hydraulic, as are the airplane, strut-type shock absorbers. The engine has a 7.8 to 1 compression ratio.

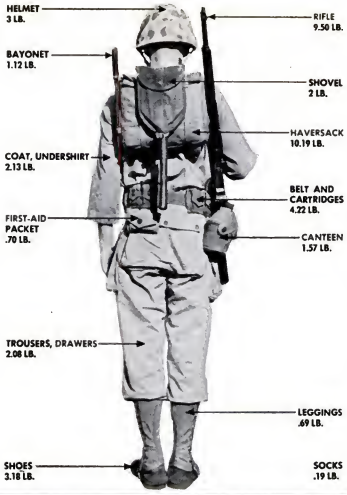
Humidity Gauge Is Pocket-Sized

THIS handy, pocket-sized thermometer and humidity indicator is well-protected in a Vinylite plastic housing. Setting the plastic calculator slide to the dry-bulb and wet-bulb readings provides a relative-humidity reading at a glance. The unit also can be mounted on the wall with a wick and small water container to keep the wet-bulb moist. The Tagliabue Division of the Weston Electrical Inst. Co., Newark, makes it.

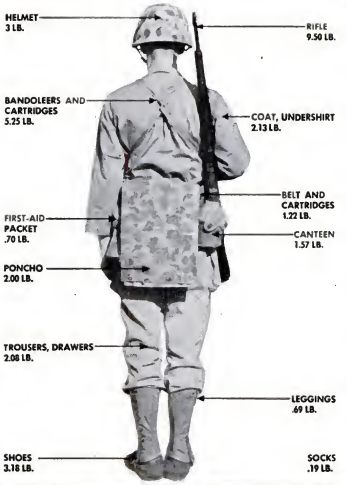
FIELD TRANSPORT PACK
TOTAL WEIGHT: 67.35 LB.

Why Marching Is Hard Work

NEXT time you set out on an all-day hike, toss a sack of flour across your back and fill your side pockets with rocks. By nightfall your aching bones will tell you how a foot soldier feels at the end of a day's march. What he packs to work is shown in these pictures, posed for PS by the Marines. The Army infantryman's gear is practically the same. The field transport pack is the one a doughfoot goes ashore with and carries on motor movements. The light marching pack is worn for foot movements and advancing toward combat. For fighting—except in winter—he strips down to the minimum.



LIGHT MARCHING PACK TOTAL WEIGHT: 40.57 LB.



MINIMUM COMBAT PACK TOTAL WEIGHT: 34.51 LB.

Mobile Belt Speeds Plane Loading

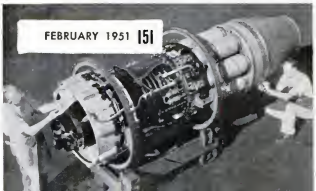
LOADING and unloading time at airports is said to be cut in half by use of this mobile cargo-handling unit. A 21-foot endless conveyer belt mounted on a small truck, the Mobiloader can handle a concentrated weight of 500 pounds or a distributed load of 1,500 pounds. Sage Equipment Co., Buffalo, makes it.

Back Seat of Car Makes Crib

TRANSFORMING the rear seat of a car into a child's bed or play pen is easy with the Kiddie Sleeper shown above. Made of Vinylite, it covers and protects the seat upholstery. The unit folds compactly for easy storage, and is made by the Kaydon Manufacturing Co., Santa Monica, Calif.

GE J-47 Jet Gets Warmer Nose

LATEST improvement on GE's powerful J-47 jet engine is special de-icing equipment. Hot air from the compressor is piped to hollow parts in the nose, such as guide vanes and support struts, preventing ice formation at high altitudes. Possibility of icing is further cut by making air-inlet screens retractable.



Diesel-Electric Tractor Has Motor in Each Wheel

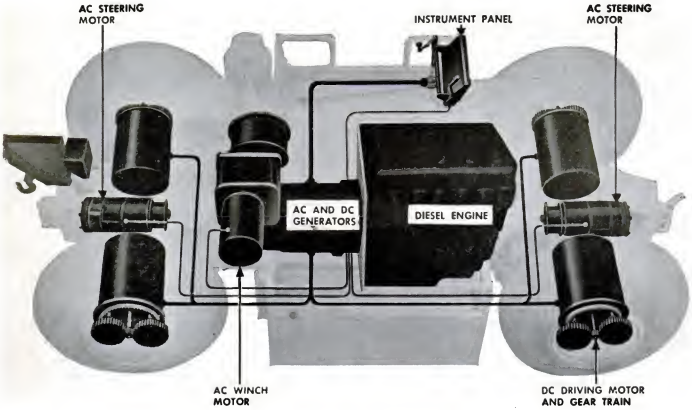
BY CROSSBREEDING Gramp's battery-driven automobile with today's Diesel-electric locomotive, engineers have hatched a husky rubber-tired tractor that has no clutch, transmission, drive shaft, or differential.

Two generators hooked directly to a 186-hp. Diesel engine grind out juice that is distributed separately to a motor in each of its four wheels, to two more for front and rear steering, and to a seventh that turns a towing winch.

Fuel to the Diesel is throttled by a hand lever that seldom needs regulating after starting. A rotating controller, like a street-car's, governs speed of the driving motors, forward and backward movement, and power braking. It's steered by push buttons.

R. G. LeTourneau, Inc., of Peoria, Ill., designed the 11-ton prime mover, called the Tournatow, for handling big airplanes on the ground. It can also be used as a switch engine in railway yards, and is being modified for heavy earth-moving equipment.

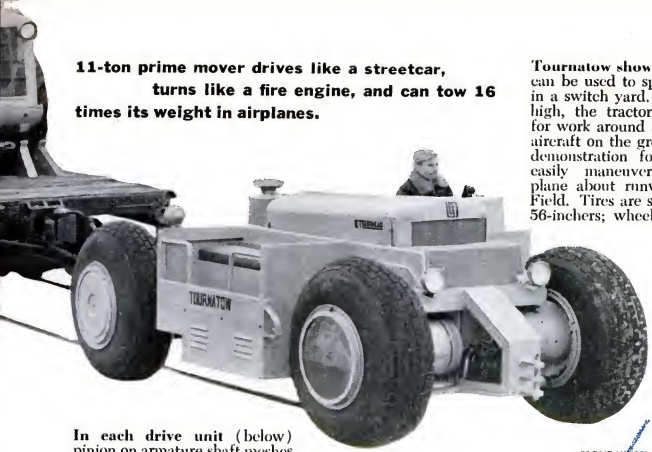
Outstanding performance characteristics claimed for the new Diesel-electric tractor are smooth starting and stopping, precise control at all speeds up to 25 m.p.h., infinite adjustment of torque to load, and a turning radius of less than its length.



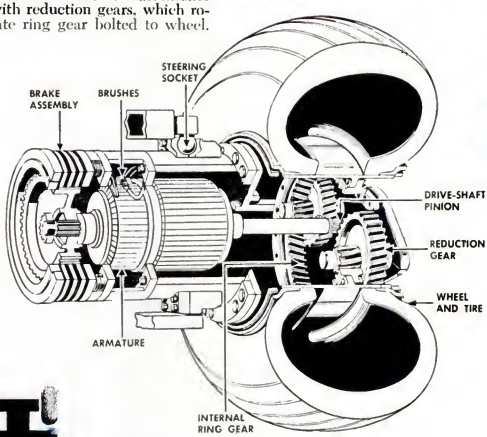
On-the-job power units eliminate usual mechanical, hydraulic, or pneumatic linkages between engine and wheels. Two generators—DC for main driving motors and brakes, AC for steering and winch—are mounted in line with Diesel engine, and power is distributed direct to point of application through cables. Engine also runs an air compressor for accessories.

11-ton prime mover drives like a streetcar, turns like a fire engine, and can tow 16 times its weight in airplanes.

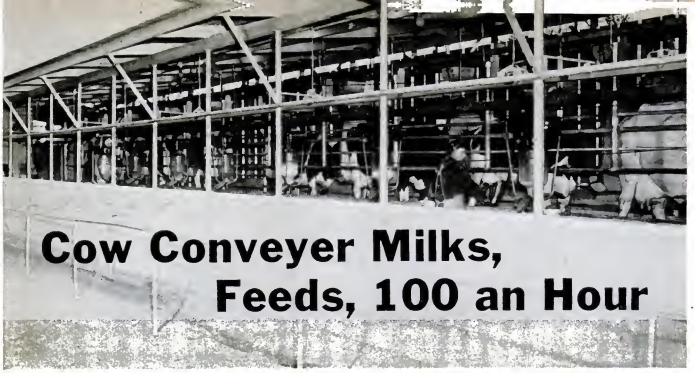
Tournatow shows, at left, how it can be used to spot railroad cars in a switch yard. Less than 6 ft. high, the tractor was built low for work around and under large aircraft on the ground. In recent demonstration for Air Force it easily maneuvered a 200-ton plane about runways at Wright Field. Tires are standard aircraft 56-inchers; wheels are identical.



In each drive unit (below) pinion on armature shaft meshes with reduction gears, which rotate ring gear bolted to wheel.



For four-wheel steering, each wheel is suspended on ball-and-socket bearing. As example of its maneuverability, 17-foot tractor turns in radius of less than 14 feet.



Cow Conveyer Milks, Feeds, 100 an Hour

Ten at a time, cows move slowly down 100-ft. automatic milking conveyer at 15 ft. a minute.

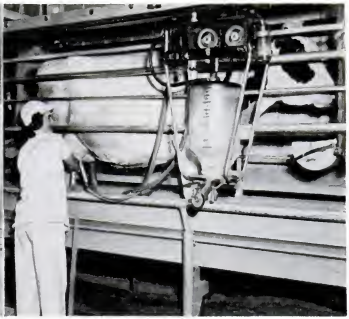
Waiting for their turn, cows queue up in single file at conveyer entrance. As each one moves up, it passes through cool-water spray from jets that washes dirt from underside of body.

COWS get everything but a shave and a haircut in an automatic milking assembly line at Delano, Calif., shown above. First they get a cool bath to wash them, then a warm one to stimulate milk flow. Next, as they ride down a 100-foot moving conveyer, they munch a meal from feed troughs while vacuum pumps remove their milk.

The conveyer holds 10 cows at a time and turns out a contented one every 36 seconds. Invented by Harry Cain for Hiett's Crystal Dairy, it requires only two attendants, one to attach the vacuum cups and one to remove them, and will handle 100 cows in less than an hour—about six times faster than two milkers working by hand.

Photos from Southern California Edison Co.

As cow enters conveyer, warm spray from upturned jets relaxes udder and stimulates milk flow. Door containing feed trough swings down automatically to form stall and provide meal.



Vacuum milking machine and 5-gal. collecting jug ride rail alongside of cow, keeping pace with conveyer. At end of line, circular return rail carries machine back to starting point.

Ring Cleats Prevent Football Spills

THE ring on the sole of the football shoe at left in the photo above is a new cleat to replace the conventional spikes shown at right. Developed at the Cornell Aeronautical Labs for the Wilson Sporting Goods Co., the self-cleaning cleat is said to prevent injuries to players from spills caused by regular cleats sticking into the ground while making fast turns.

Safety Gloves Reflect Headlights

BY DAY, Glo-Glovs are a pair of well-tailored dress gloves in capeskin, pigskin, or calf. By night, they become a useful safety aid for a driver to signal stops and turns. The back surface of the glove is made of Scotchlite, a reflective fabric that shines brightly in the light of auto headlights two blocks behind. Glo-Glov Co., Chicago, prices the gloves at $4.95 and up.

Navy Develops First Automatic Pilot for Helicopters

THAT smile from a Navy helicopter pilot (above) signals success in a test of the first automatic pilot developed for the flying windmills. With both his hands off the stick, the 'copter hovers steadily 5 feet above the field. All forward, lateral, and stabilizing controls are handled by a hook-up of five gyroscopes and parts from standard airplane auto pilots. The device was designed by engineers of the Naval Air Experimental Station, Philadelphia, who are now adding altitude and power controls.

Not bomb wreckage—just pictures

Hot-water blast cost $18,000 in Ohio home.

Someone left gas on after supper in church basement.

Overheated water tank wrecked brick house.

This was bathhouse in vets' housing project.

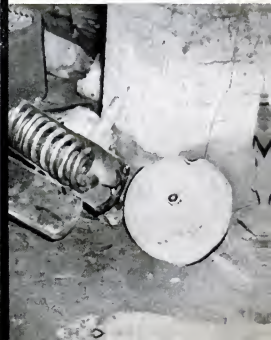
Investigators say missing tank had no safety valve.

Pennsylvania home-owner and ex-furnace.

In school below one died, 19 were hurt.

Arrow shows tank's path from cellar through roof.

Rest of this furnace stopped 3 floors up.



proving that

Water Can Be Dynamite

..... But not if you do this

Even a 30-gal. storage tank can let go like a TNT blast unless protected against excess heat as well as pressure.

By William Gilman
DRAWINGS BY ELEANOR GILMAN

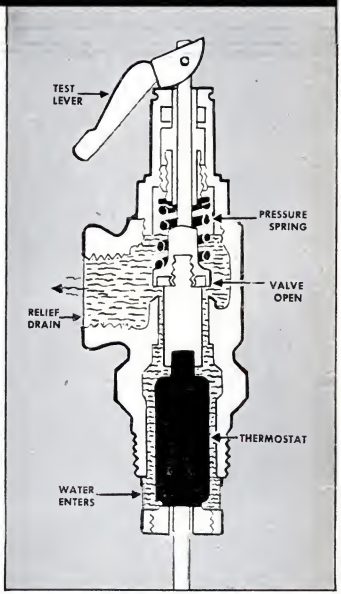
THAT harmless-looking hot-water tank down in the basement can become a live bomb quicker than you may think.

Its job is to furnish household water at around 150° F.—safely below the boiling point, yet plenty hot enough to handle dirty clothes and greasy dishes. The trouble comes when the setup doesn't have properly functioning brakes. Since water has to be under some pressure in order to flow from plumbing fixtures, it can be heated past its normal boiling point—without boiling. That's when even a modest 30-gallon tank can let go with more explosive energy than a charge of TNT.

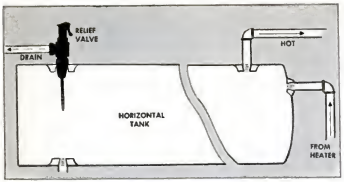
It can happen with an apartment house boiler as quickly as with a cheap little hod-a-day pot stove or side-arm coil supplying a storage tank. The chief difference is that a cast-iron boiler flies apart like shrapnel while a steel tank is apt to soar like a rocket.

But such blasts can't happen when proper equipment is properly installed and maintained. In every case, the explosive material is what one engineer calls "water gone crazy with the heat." It's the flash into steam *after* pressure ruptures a tank or boiler that causes trouble. Sometimes, the pressure has been built up too high; other times—if the tank is old and weakened—even normal operating pressure is too great.

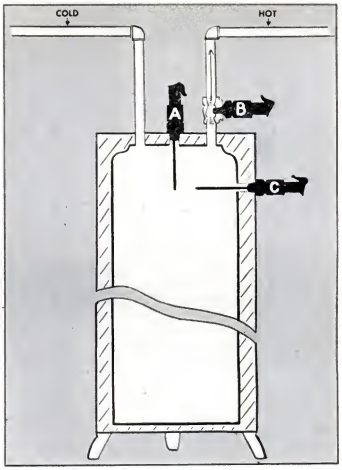
In either case, pressure sets the stage. The real villain is superheated water. Every



Best insurance against hot-water explosion is relief valve that responds to either excess pressure or temperature in tank. Photo at top shows plumber putting one into hot-water line from gas-fired heater. As shown in cutaway view, overheated water expands thermostat, lifting valve and letting water escape until temperature is brought down by cold water entering tank. Under dangerous pressure, water acts directly against spring to lift valve. Raising test lever makes sure valve is not stuck.



Where to put temperature-pressure valve: Horizontal storage tank usually has tapping into which valve can be installed as shown above. Automatic systems that both heat and store water vary in design; follow manufacturer's instructions. Sketch at right shows three approved locations for different types. In positions *A* and *C* thermostat needs tip extending into hottest water. In position *B* there must be no shutoff between tank and safety valve.



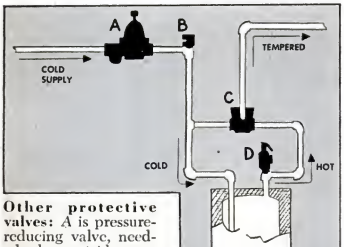
drop is waiting ominously for its chance to flash into normal steam. A break in the tank gives it that chance.

When blast experts are able to find enough pieces in the wreckage, they can almost always assign one of three causes to the accident.

1. The setup was a manual one. This isn't bad in itself, but whoever lit the heater fire forgot to turn it off. Like the family in a last-minute hurry to get started on a trip, or the careless baby-sitter.

2. The installation had automatic controls —but too much faith was placed in them. Mechanical robots are fine, but need periodic checking.

3. Or it might have just been what engineers of the Hartford Steam Boiler Inspection and Insurance Company—oldest company of its kind in the country—call a plain "goofy" setup. Like installing a check valve between the tank and its relief valve. Or plugging the relief valve to stop its leaking. Such tinkering, obviously, makes a safety valve a useless ornament.



Other protective valves: *A* is pressure-reducing valve, needed when outside pressure is too high for house system; it also guards against "water hammer" shocks. *B* is vacuum-relief valve that prevents tank's collapsing or burning out in case of vacuum condition that can siphon water from heater. *C* is tempering valve that guards against scalding water reaching faucets. *D* is standard temperature-pressure relief valve described earlier.

"Hot-Water" Earthquake

There's the case of the policeman who phoned headquarters that there had just been an earthquake. The shock came from a hot-water blast four blocks away, which caused $10,000 damage to neighboring buildings. It all started with a dripping hot-water faucet in a hamburger stand. To save water, when he locked up at night the proprietor shut off the cold-water line to the automatic gas heater serving a 20-gallon tank. That was blunder No. 1.

No. 2 was the fact that the setup had no safety valve. And as pressure of the heating water increased, it couldn't get relief by bucking up into that closed cold-water line.

To be sure, the heater had an automatic fuel control. It *should* have shut off the gas when the water got too hot. But this thermo-

stat happened to be gummed up. So the fire kept on going, and the tank finally burst.

For every blast, there must be the two ingredients—failure of the tank under pressure, and explosive energy built up when the water gets too hot. It's usual to think only in terms of pressure. By itself, excess pressure will damage a tank and cause a watery mess in the basement. But for a real hot-water blast, the water has to be past its atmospheric boiling point.

To prove this, a dozen ordinary hot-water heating tanks were blown to bits in a hayfield near Doylestown, Pa., while a couple of hundred plumbing experts and boiler inspectors watched from a safe distance.

High spot of the bombing came with the eruption of a typical 30-gallon steel tank inside a small house. Its pressure just before the blast was 80 pounds, which is a normal safety-valve setting for a good flow of water from upstairs faucets. But the water had built up to 290°—78° above its normal boiling point.

Tanks Are Urged to Explode

To highlight the lesson, cooler water in two similar tanks was safely built up to 200-pound pressure. When nothing happened, each was urged to explode by giving it a water-hammer effect—an abrupt jolt of pressure. A rifle bullet was shot into one. With the other, an engineer just stepped up and split the tank with a sledge.

Neither tank exploded—just a gush of water rushed out through the breaks.

The Doylestown tests were staged by the Watts Regulator Company, a Massachusetts firm pioneering in safety devices, to prove that ordinary pressure-relief valves—though still a *must*—should be backed up by a temperature-sensitive safety device in case the pressure valve can't handle the situation.

What's needed is a combined temperature-pressure relief valve. The Watts patent on such "T-P" valves has now expired and many firms make them. Some have a fusible plug that lets go when water gets too hot. Latest types work on the thermostatic principle to open the valve.

After a dime-store blast 20 years ago that injured 50 persons and killed five, Washington, D. C., became the nation's first municipality to insert a temperature-control requirement in its building code. A number of other states and cities, aware of water's dynamite power, have followed suit.

The ordinary home-owner can take a les-

In demonstration of water explosion, tanks in and outside a frame building at Doylestown, Pa., were subjected to varying heat and pressure.

From protected pit engineer regulates heat and pressure of water and watches remote-registering gauges as explosive force builds up in tank.

Building is blasted to kindling as overheated water hurls shell of storage tank 400 feet into the air and 100 yards across country.

Here are remains of 30-gal. tank in which water under only 80 lb. pressure was heated to 290° F.—78° over normal boiling point.

son from industrial plants, which regularly inspect high-pressure equipment. Actually, say engineers, there's too much false security with "low-pressure" hot-water systems in residences. "Low-pressure" means simply that that's all they're built to stand. Four-fifths of the claims paid by a typical insurance company result from accidents with low-pressure equipment.

Every setup has its own pressure limit. Fifteen pounds may not be too much for a hot-water heater tested at 250 pounds and intended to operate at around 50, but it's the recommended limit for the usual low-pressure steam boiler made of cast iron. And when the low pressure becomes high—if a valve sticks, or aquastat fails, or water gauge goes haywire—something has to let go. Pressure below the rated limit may still be excessive for a particular tank—old, corroded, or weakened by past overheating.

Anything that relieves excess pressure is to the good. That's why an open system—like water gravity-fed from a spring—is generally safe because water can back up the line. But it isn't foolproof. Sediment or freezing might block the line.

Some explosions have been innocently caused by a town's desire to protect meters from overheated water backing up into them. Check valves to protect the meters also block the escape of overheated water.

Best Protection Is Good Equipment

The best protection is making sure you have good equipment installed by a plumber who knows what he's doing—and by checking it every few months. You can't just walk away and leave it. A reliable heater comes with an operating manual. If you follow instructions, you can put the heater through its paces to check.

That thermostatic valve is going on and off many times a day. By contrast, a pressure-relief valve just sits on the line waiting month after month for an emergency. To keep in trim, this robot needs exercise. Long idleness, sediment, or corrosion may cause it to get stuck. That's why its test lever should be operated every few months. If your valve is an older type, the spring can be pushed back with a knife to imitate excess pressure. If it squirts, it's okay.

The last warning—if you're lucky—comes when you turn on the hot water and get boiling water or steam. Better get the situation cured in a hurry, because you're playing with dynamite. END

What Is It—Plane or Truck?

THE strange-looking contraption shown above is a mobile unit for testing airplane engines and props before installation aboard transports of the Trans-Canada Air Lines. A steel frame built on a three-ton truck holds the engine, which is controlled from the truck cab. The unit is prevented from moving forward by chains running to tie-down rings in the ground. Hydraulic spider legs absorb torque and stabilize truck during tests.

Oversize Bandage Covers Big Burns

DEVELOPED by the Army Medical Corps, these new oversized dressings are for burns and wounds covering large skin areas. A layer of highly absorbent gauze protects the injury, while a nonabsorbent outer layer prevents the entry of bacteria. Dressings may be worn as long as two weeks instead of requiring frequent changes. To prevent contamination, bandage is packed in a sealed plastic bag.

Much fine glassware is still handmade by expert craftsmen, as it has been for centuries.

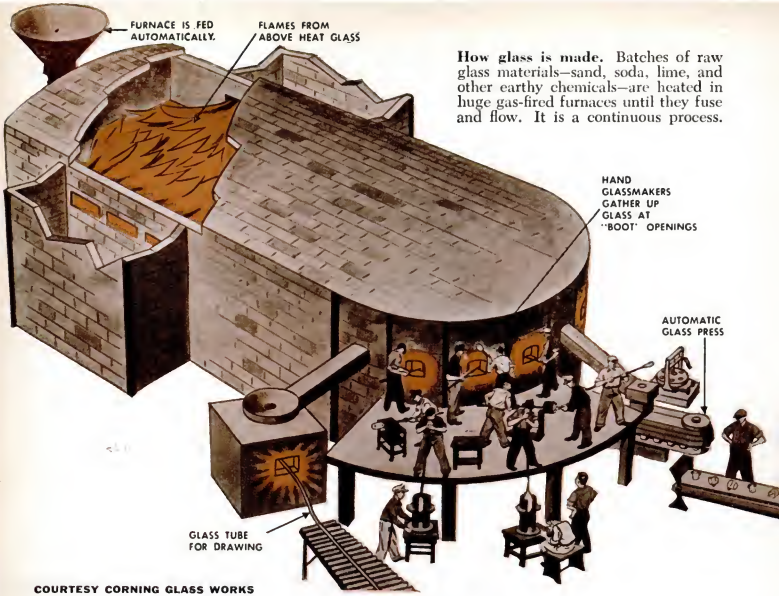
How Your Glassware Is Made

By George H. Waltz, Jr.

TWO opposite extremes in manufacturing —meticulous handwork by skilled craftsmen and high-speed mass production performed by automatic machines—provide the wide variety of household glassware we use each day.

Up until 1903, all types of table glassware, ranging from tumblers to vases, were either hand-pressed or hand-blown by master artisans. Then came what is considered to be the greatest single advance in the 5,000-year history of glassmaking—the perfection of an automatic glass-blowing machine that put glassmaking on the production line.

As early as 1889, the idea for a mechanical glass blower began to form in the mind

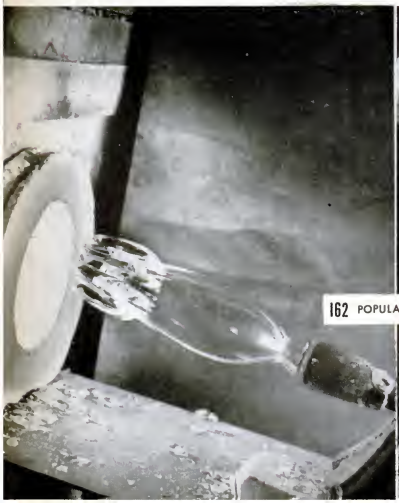


How glass is made. Batches of raw glass materials—sand, soda, lime, and other earthy chemicals—are heated in huge gas-fired furnaces until they fuse and flow. It is a continuous process.

COURTESY CORNING GLASS WORKS

3 **Periodic reheating** in a small furnace called the "glory hole" is necessary to keep the glass at just the right temperature for working. The base of the vase, with its decorative ribs of glass, is now complete.

4 **A pontil** (pronounced "punty"), which is a steel rod with a serrated tip, next is attached to the completed base of the vase with a tiny glob of molten glass. The top of the vase then is cut away from the blowing tube.

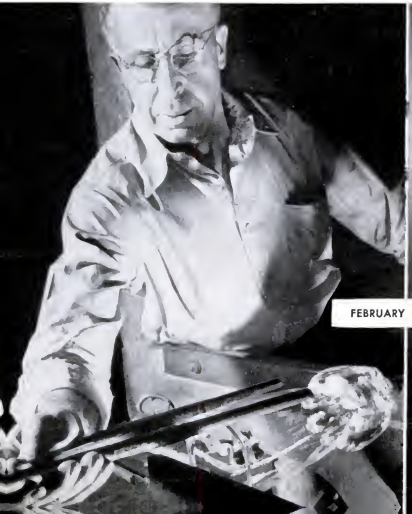


1 Glassmakers work in teams. A "gather," or glob of glass, first is dipped up from the tank on the end of a blow tube by a man called a "gatherer." The "serviter," No. 2 man on the team, blows it into its basic shape.

2 The master glass blower, known in the glass shop as the "gaffer," then takes over. In the case of this vase, his first job is to apply decorations in the form of glass brought to him by another assistant, the "bit gatherer."

5 A "wood-jack," a tweezerlike tool with apple-wood tips, then is used to shape the flair of the vase. Because the wood tips burn away when brought in contact with the hot glass, they must be replaced frequently.

6 The finished vase, after careful and slow cooling on an endless belt that travels through an annealing oven or "lehr." The annealing process takes 5 to 8 hours. These photos were made at the Steuben Glass Works.



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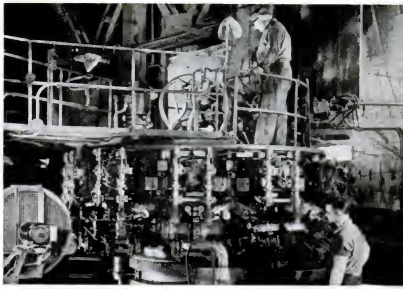
of Michael Owens, a master blower at a glass works operated by Edward Libbey in Toledo, Ohio. One day while Owens was struggling with a particularly inept crew of apprentice glassmakers, he wondered if it wouldn't be possible to devise a machine to take their places. Secretly, he designed and built a wooden working model of such a machine. When he showed it to Libbey, the boss was so impressed that he agreed to set up a company to carry on the experimental work with Owens as general manager.

Machine Works like Bicycle Pump

Owens' first full-size machines were simple and ingenious—and they worked. They operated on the principle of the bicycle pump. When a piston was withdrawn, molten glass was sucked up into a metal mold from a supply pot. When the piston was pushed in, the compressed air forced the molten glass against the sides of the mold to form the desired shape. It was as simple as that, and the same basic principle is still used today in the modern machines that produce the major portion of our low-cost household glassware.

Automatic machines, however, have by no means completely replaced the master glass craftsman. Expensive glassware is still created by the same so-called "offhand" blowing methods that have been followed for centuries. At glass works like those maintained by Steuben Glass, Inc., at Corning, N. Y., skilled glassmakers still use the ancient processes and the crude tools of their craft to turn out decorative tableware and other glass art objects.

They still stick to the old "shop" method of glassmaking in which a master blower, known as a "gaffer," supervises five assistants. Directly under the gaffer is his "serviter" who blows the glass into its basic form. Then in order come the "gatherer" who gathers or picks up a glob of molten glass from the glass furnace on the end of a blowing rod and gives it to the serviter, the



1 Automatic mechanical blower replaces the human team in the production of inexpensive, everyday glassware. A machine such as one above turns out 24,000 tumblers a day.

4 After annealing, glasses are carefully inspected in front of the screen of a polariscope. Polarized light from polariscope reveals any stresses that might cause breakage.

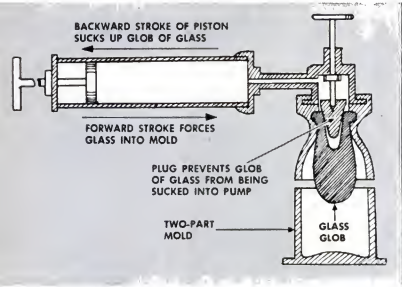
5 Silk-screen printing is used to apply the designs to glasses in the new "Horseless Carriage" Libbey Glass line. After basic design is drawn, silk screens for printing are made.

"bit gatherer" whose job it is to gather up on a long stick called a pontil (pronounced "punty") the small amounts of additional molten glass needed for decorations, stems, etc., the "stick boy" who holds the gathers, and finally the "carry-in boy" who carries the finished piece to the oven, called a "lehr," where the glass is annealed.

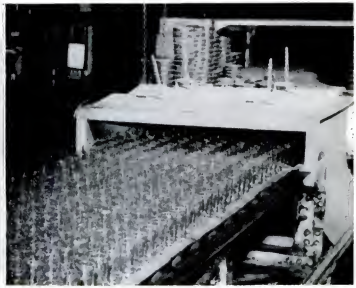
The six men work as a team, with the gaffer calling the signals. He is the artist, the master, who carefully shapes the molten glass (or "metal" as the glassmakers call it) into its final form. His skill comes from long experience.

Glassware made by pressing, rather than blowing, is another traditional type that is still produced, but it too for the most part is now turned out on automatic machines. Many items such as heatproof ovenware, some types of lenses, and decorative ornaments are made in modern, automatic glass presses.

By blending handwork with machines, the glassmakers are making everything from cheap but attractive dime-store tumblers to expensive crystal works of art that enliven our dining tables for festive occasions and decorate our homes. END



2 Working like a tire pump, the machine sucks a glob of molten glass up from a revolving supply pot in its base and then forces it against the sides of a two-part metal mold.



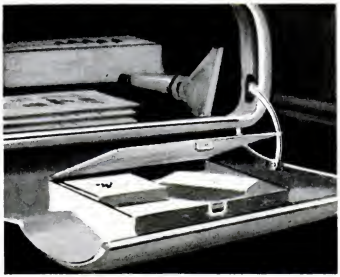
3 Annealing to eliminate any possible strains in the glass also is an important operation in the production of machine-made glassware. Cooling requires from 45 to 90 minutes.

6 Ceramic colors are applied, one at a time, in the printer shown above. After all colors are in place, glasses are baked in oven to fuse colors to the glass. They are then re-annealed.

7 Finished glassware as it comes from the final annealing. These photos showing the mass-production of glasses were made at the Libbey Glass plant of Owens-Illinois Glass Co.

I'd like to see them make . . .

Everyone has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science* will pay $5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.



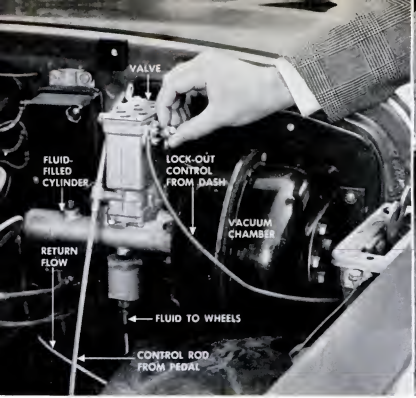
A storage box for fuses built into a car glove-compartment door. Loose fuses in the compartment never seem to be around when you need them. With this box you'd find them easily.—*Norman L. White, Athol, Mass.*

A position lock or friction drag on the thumb screw of adjustable wrenches. Such a lock would prevent the inevitable slip-back of jaws that causes slips and rounding of the head.—*Duncan Osborn, St. Petersburg, Fla.*

Shaving brushes and razors with magnets set into the handles. Then they could be suspended from metal shelf supports or firmly held to the sides or under the shelves of metal cabinets.—*George Perry, Fitchburg, Mass.*

A clamp that would lock the blades of a lawn mower when it is stored where children might get at it. It should be easy to remove but difficult for youngsters to master.—*Matthew C. Godfrey, Detroit, Mich.*

Frozen foods with waxed cards dividing the blocks. This would make it easy to break the blocks in two, providing smaller portions for small families and allowing the excess to be stored frozen.—*Mrs. P. Morrell, Hampton, Va.*



Brake mechanism bolts to firewall. Diaphragm in vacuum chamber drives piston into fluid-filled cylinder, sending brake fluid to wheels.

New two-in-one pedal is mounted over old accelerator so it can rock back and forth. Original brake is left in position for emergency use.

New Two-in-One Foot Control Stops Car or Speeds It Up

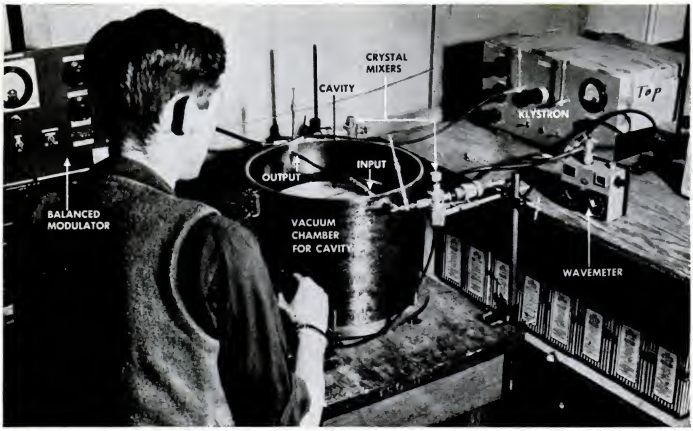
Now you can step on the gas or put on the brakes with the same foot pedal. Press forward with your toe, and the car speeds up; press backward with your heel, and it slows down. Called Accela-Brake, it is controlled by a pedal that bolts to the car floor over the conventional accelerator and is pivoted so it can rock forward and back. Pushed forward, it presses down the accelerator. Tipped backward, it pulls a control rod that actuates a special brake mechanism installed between the master brake cylinder and the wheels.

When the rod is pulled, it opens a valve that applies vacuum from the car manifold to a rubber diaphragm inside an air chamber. This collapses the diaphragm, driving a piston into a cylinder filled with brake fluid. The piston forces the fluid out of the cylinder and into the wheel brakes, slowing or stopping the car depending upon how far the pedal is pushed backward.

The auxiliary brake does not interfere with the operation of the conventional brake, and a lock-out control on the dash disconnects it at any time. In addition to speeding up braking time, it is also said to eliminate roll-back on hills and foot fatigue in traffic. Made by the Accela-Brake Sales Co., of Hollywood, it sells for about $66.

Navy Flying Boat Makes Tight Turn

THIS Martin flying boat can't quite turn on a dime, but with its hydroflaps — twin underwater rudders — it can turn in a radius one and a half times its wingspan — three times sharper than with engines alone. Designed for maneuvering in tight waters, the rudders can also be used as a brake.

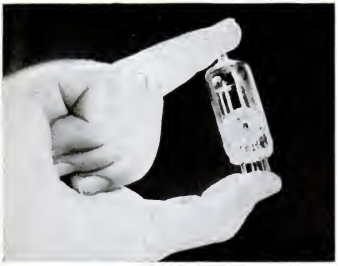


Light Proved Even Faster than Previously Determined

THE speed of light, the magic number that affects nearly all laws of physics, is even faster than scientists thought. New experiments at Stanford University place it at 186,280 miles per second—eight miles per second higher than the old value. Even this small change may be important in radar and Loran. The researchers actually measured the speed of a radio wave—which is the same as that of light—by finding its resonance frequency in a "cavity" whose dimensions are known to a millionth of an inch.

Tiny Magnetrons Made for UHF TV

THIS tiny tube may be a vital part of the television sets of tomorrow. It is a miniature magnetron, adapted from wartime radar tubes for use in ultra-high-frequency TV receivers. Many—perhaps most—of future TV stations are likely to operate in the UHF region, now being used only experimentally (PS Aug. '50, p. 111). GE is already making a few of the small magnetrons, which produce ¾ of a watt at 30 to 900 megacycles.



Jet Noises Tried Out on Guinea Pigs

JET engines make a lot of noise—enough to pain or perhaps harm your ears. To find out more about the effect of very loud noise on human ears, Air Force scientists at the Wright-Patterson Base are learning what it does to guinea pigs' ears. The anesthesized animals (below) are placed in a soundproof room equipped with sound generators. Those are not earphones Dr. H. E. von Gierke is wearing, but muffs to protect his ears.

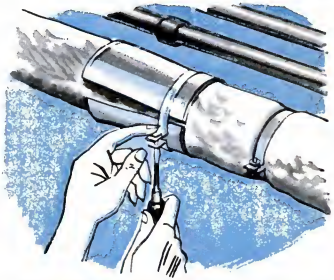
Keeping the Home Shipshape

If it's raining or snowing when you leave for the market, carry along a plastic shoulder protector from your closet. It will fit over the shopping bag and keep your groceries dry.

Cup hooks screwed into the wooden rail in a closet, or to the door, will hold those belts that clutter up a drawer. They'll hold suspenders and extra shoelaces as well.

You can protect your hands from abrasion when grating cheese, carrots, and other foods by wearing the heavy rubber fingers used in offices. Cover thumb and first finger.

Wood from crates and apple boxes makes fine stock for craftwork. A home-made tool like this mallet will enable you to knock them apart without damaging the wood.



Separated joints in the asbestos on your heating pipes can be covered with tin cans with top and bottom removed. Slit them lengthwise and clamp them on with pipe-covering bands.

Please turn the page for five more suggestions.

Keeping the Home Shipshape

If you don't cover your porcelain-topped or stainless-steel sink with rubber pads, protect the shiny surface by putting a dishcloth under pots and pans when scouring them.

A plywood board, dividing your hamper into two sections, saves you time on washday. Keep white wash on one side and colored wash on the other, and sorting is eliminated.

You can add water to an aquarium without disturbing plants and sand if you float a board about ¾" thick on the surface of the water. Pour the water lightly onto the board.

You can make a jumbo dust pan for your shop by removing the long side of a large, tin cake pan. A file handle, attached with a long screw or bolt, makes a good handle.

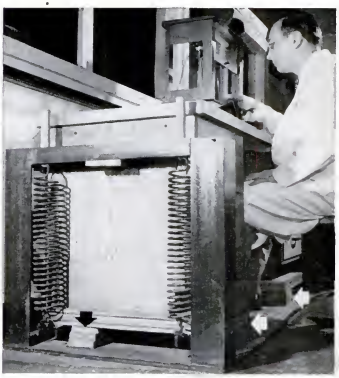
A storage wall of orange crates, with each bin labeled, will save a lot of last-minute hunting for Christmas bells, Easter baskets, Halloween masks, and other holiday trappings.

Dummy Bombs Test B-36 Accuracy

DROPPED from a B-36 bomber, these concrete-filled, 12,000-pound, dummy bombs help tell Convair engineers just how real bombs will behave. When the bombs are released—some from as high as eight miles up—an electrical impulse sent to the ground automatically starts cameras that track the missiles, recording drop path and rotation. Depth of ground penetration is measured to tell what the explosive pattern would be.

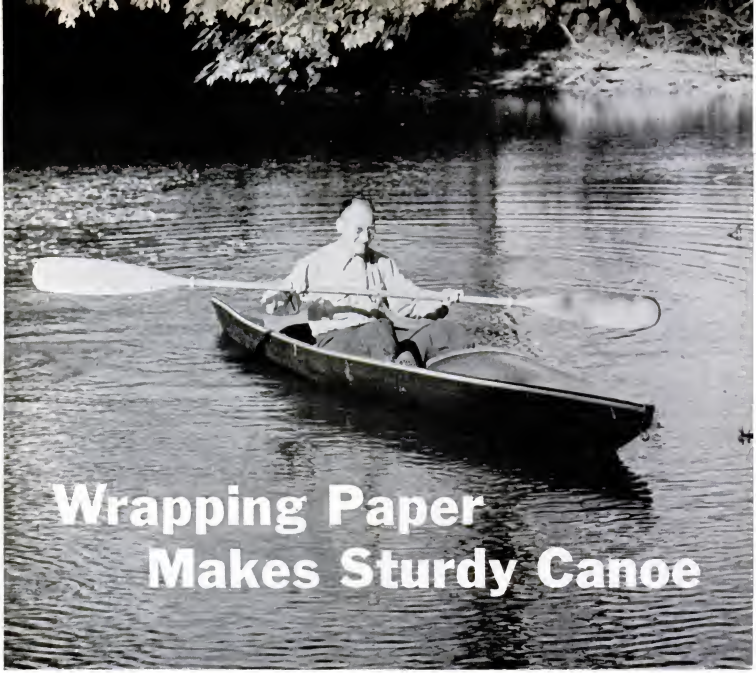
"Hot Stick" Takes Tank Temperature

WHEN U. S. tanks roar into battle on hot desert sands, their rubber treads must withstand scorching ground heat that often gets 34° to 39° hotter than the air above it. To take the temperature of the sand and the treads, corpsmen jab them with this special needle-nosed pyrometer that registers minute amounts of current generated by heat on a dial calibrated in degrees. Repeated jabbings show the rubber treads can withstand up to 180° F. without damage.



"Floating Table" Licks Vibrations

DELICATE balance scales, placed on top of this "floating table," are unaffected by the poundings of a nearby giant drop forge in the Westinghouse plant at Pittsburgh. Suspended from heavy coil springs and cushioned by large blocks of foam rubber (arrows), the table absorbs all vibrations before they reach the sensitive apparatus. Steel plates, bolted to the bottom, preload the table so objects placed on top do not throw the delicate balance out of equilibrium.



Wrapping Paper Makes Sturdy Canoe

Paper-hulled *Shoshiman* has spent two seasons in rougher streams than the Passaic (above).

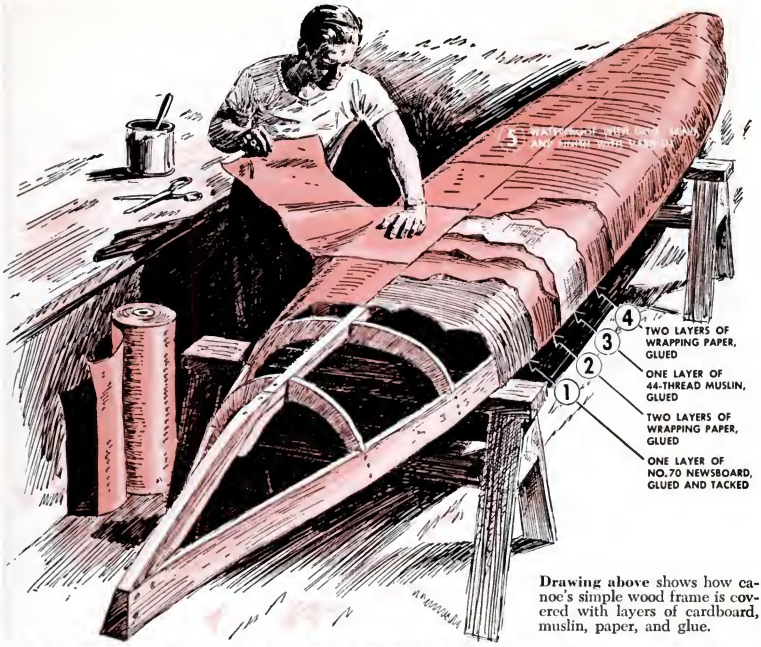
THAT canoe in the picture above is made of paper. Its hull is plain, ordinary, brown wrapping paper, the kind the hardware merchant packs your nails in. Yet it is as sturdy and seaworthy as a commercial job.

If you can operate a hammer, saw, scissors, and glue brush, you can make one like it in a couple of weeks' spare time. So reports John B. Ehrhardt, suburban-weekly editor of Madison, N. J., who resurrected the lost art of paper-boat making to build *Shoshiman*, the canoe shown on these pages. He adapted the technique used in the 1870's by Elisha Waters & Son, of Troy, N. Y., who made paper boats and also paper domes for astronomical observatories (the one at West Point, installed in 1881, is still good as new).

The paper boats have no seams and little framing. You can build your own frame, or use the frame from a stock kayak kit. Besides the frame, you'll need about seven quarts of water*proof* glue (Ehrhardt used Cascophen), a dozen 18″ by 24″ sheets of No. 70 newsboard (a type of cardboard), 10 yards of 44-thread muslin, and lots of brown wrapping paper.

Cover the frame with one layer of newsboard, fastening it with glue and tacks. Butt the joints. Next apply two layers of paper, coating both surfaces with glue. It's easier if you cut the paper into 12″ by 18″ sheets and dilute the glue with about 20 percent water. The paper joints should be lapped and staggered, with wide laps around stems and keel. A layer of muslin, laid in bands from gunwale to gunwale, with the cloth doubled and the joints butted at the selvages, follows. Glue the same way as the paper. Finish with two layers of paper.

Let the glue cure for two days, then waterproof the boat inside and out with another coat of diluted glue. Wait 48 hours, and then sand and paint the hull, treating it like wood. Now you're ready to launch.



Drawing above shows how canoe's simple wood frame is covered with layers of cardboard, muslin, paper, and glue.

One man easily handles the paper canoe, which weighs approximately 50 pounds, similar to commercial aluminum or plastic boats. Materials cost $45 (not including ready-made frame).

Spring a leak? Paper and glue fix that, as Ehrhardt demonstrates above. His boat, used two years, sprang its only leak when hung up on rock. That one was too minor to bother patching.

Aids to Modern Living

Electric Hamper Dries Clothes. A fan in the bottom of this aluminum hamper sends a blast of air warmed by a heating element upward to hasten the drying of lingerie, towels, or diapers hung inside it. In summer the appliance can be used as a bathroom air conditioner simply by hanging damp towels inside and switching on the fan to circulate cool air. Hamper-Dri has a 110- to 120-volt AC motor. Argyle Mfg. Co., of Colchester, Ill., sells it for $29.95.

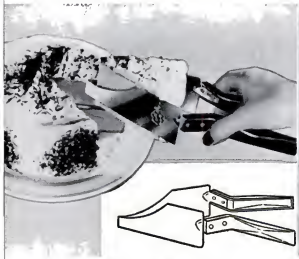
Barbecue for Indoors or Outdoors. Interchangeable posts on this grill let it be installed indoors in a fireplace or outdoors in a picnic area. A handle on the grill moves it over the fire for cooking, out to a magnesium tray for removing food. Placed on the wire grid, the tray becomes a griddle. It is sold by Lyncraft Products Co., Lake Orion, Mich., for $19.95.

Labels Are Easy to Mark. For identifying frozen foods and other packages, a new self-sticking tape adheres to metal, glass, or plastic. It has a blue border and white writing surface that can be lettered with any pointed instrument. Lettering comes out blue. Sold with dispenser by the Labelon Tape Co., of Rochester, N. Y., it is priced at about 50¢.

Rack Keeps Tools Handy. Mounted on a garage or basement wall, the rack above has room for storing six long- and five short-handled gardening or household tools. It is made by the Inland Steel Products Co., of Milwaukee, Wis. The toolholder comes with screws and bolts for easy installation.

Tubing Stops Slamming. As a door equipped with Hold-a-Door opens, telescoping tubes inside a sleeve pull apart. Temporary vacuum holds door open 8 to 40 seconds, then lets it close. Knipe Industries, Lawrenceville, N. J., sells device for about $3.

Resins Purify Water. Distilled water for steam irons and storage batteries can be drawn from the kitchen faucet if this refillable Filtr-Ion tube of resins is attached. Resins, blue-black at the start, turn yellow when exhausted. La Motte Chemical Products Co., Baltimore, makes it.



Knife-Tongs Prevents Crumbling. To cut and serve cake portions with one hand, spread this flexible, V-shaped cutter to the desired slice size, press its sharp edge into cake, then lift up with cake held firmly in the blade. Krag Steel Products Inc., Chicago, sells the cutter for $2.

Tool Kit Fits Pocket. Besides having a blade, this steel knife boasts a ¾-inch monkey wrench, a hammer, drill bit, awl, and file with screwdriver tip. Imported from Germany, the knife is 4¼ inches long. Hoffritz for Cutlery, New York City, prices it at $9.95.

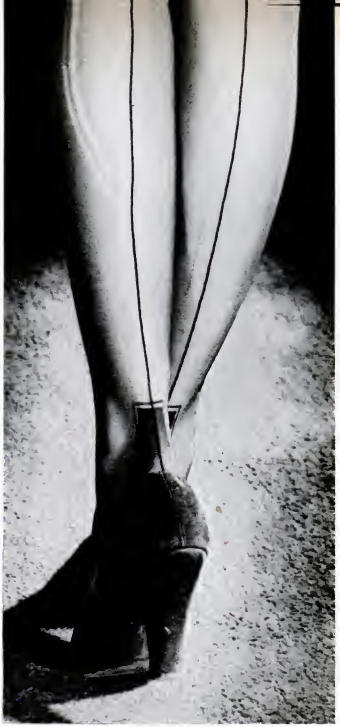
Rollers Move Quietly. Designed for hospitals, these plastic curtain rollers with stainless-steel hooks are said to eliminate noise when slid along a metal track. Made by Grant Pulley & Hardware Co., Woodside, N. Y., the curtain assembly can be mounted on a ceiling, or built flush with it.

Plastic Helps Prevent Runs

AN AIR FORCE mechanic (we'll get to the legs in a minute) was spraying a protective dope on fabric airplane wings when he got an idea: Maybe a similar coating would protect women's fragile stockings.

As a result, you can get a clear-plastic coating, called Nylonger, that you can spray on silk and nylon stockings in a few minutes. Packed in the new self-dispensing spray cans (PS, Dec. '50, p. 102), it coats each thread with a thin, invisible plastic film that adds strength and reduces wear. Where threads cross, the plastic "spot-welds" them together so they are less likely to unravel and cause runs if snagged.

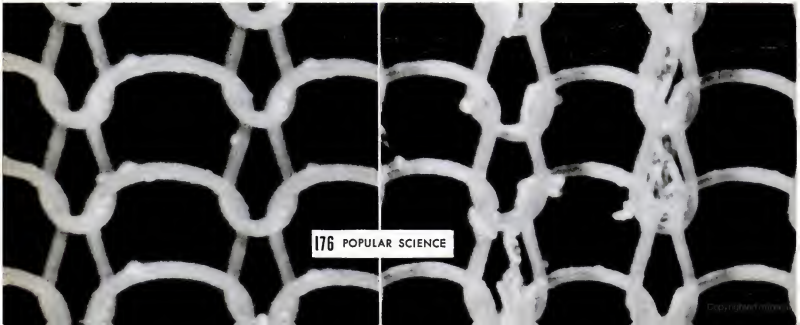
Said to increase stocking life from two to nine times, the plastic sells for $1.98 a can, enough for about 70 sprayings.



Here's what happens when untreated stocking is snagged. Broken threads start run that ruins entire stocking. If treated, the threads are less likely to unravel, and snag is kept small.

Magnified views of same stocking mesh show how threads look before treatment, below, and after treatment, at right. Photos show microscopically small threads enlarged about 50 times.

In treated stocking, threads are coated with tough, flexible film of plastic that cuts wear, increases life. Where threads cross, note tiny globs of plastic that glue strands together.



MECHANICS
and
HANDICRAFT
REG. U. S. PAT. OFF.

The Inside Story of Our Expansion Attic

How a young couple converted an empty attic into three extra bedrooms, and showed a cash profit on their spare-time work.

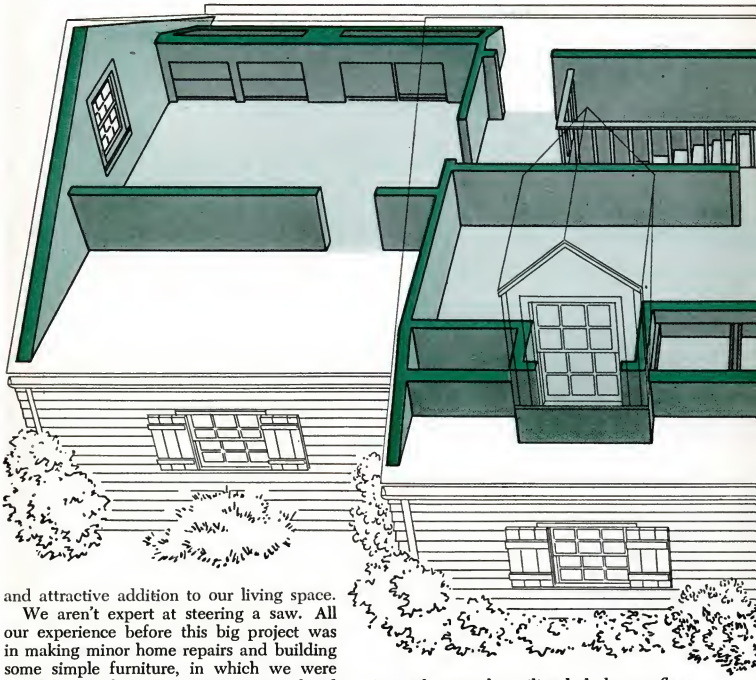
By Mary Ellen Goodman
PS STAFF PHOTOS

WHEN my husband and I decided we would like to expand our "expansion attic" into three rooms and bath, we called in a contractor for an estimate. Then we looked at our bank account, and it didn't take a certified accountant to see that we'd have to do the work ourselves. We're glad we did. The job was fun, and it paid off.

What we saved. The contractor gave us an estimate of $2,450 for putting in three bedrooms, without the bathroom. As I total up our own costs, I find we spent $378 for outside labor and $520 for materials. So we saved almost $1,500, in exchange for 300 hours of our spare time. As amateurs, we consider $2.50 per hour for each of us pretty good pay. And we now have a sound

An architect representing POPULAR SCIENCE, J. Conrad Breiby (at left), helped Gerson and Mary Ellen Goodman plan the project described in this and other articles that will follow. Their baby, one-year-old Steve, looked over the blueprints of his future quarters as critically as did his parents. Below is their home as it looks now. It faces west. The plan the Goodmans chose to finish their attic appears on the next page. They expect to put small hopper-type windows in end walls of center section later on to increase light and cross ventilation.

There was plenty of room in our attic. Now we have three



and attractive addition to our living space.

We aren't expert at steering a saw. All our experience before this big project was in making minor home repairs and building some simple furniture, in which we were aided by an elementary text on using hand tools. We have no power tools, and managed nicely without them at first. Later, POPULAR SCIENCE lent us an electric drill and an 8″ bench saw to speed up the cabinet work. Both were a help, but we could have done the job without them.

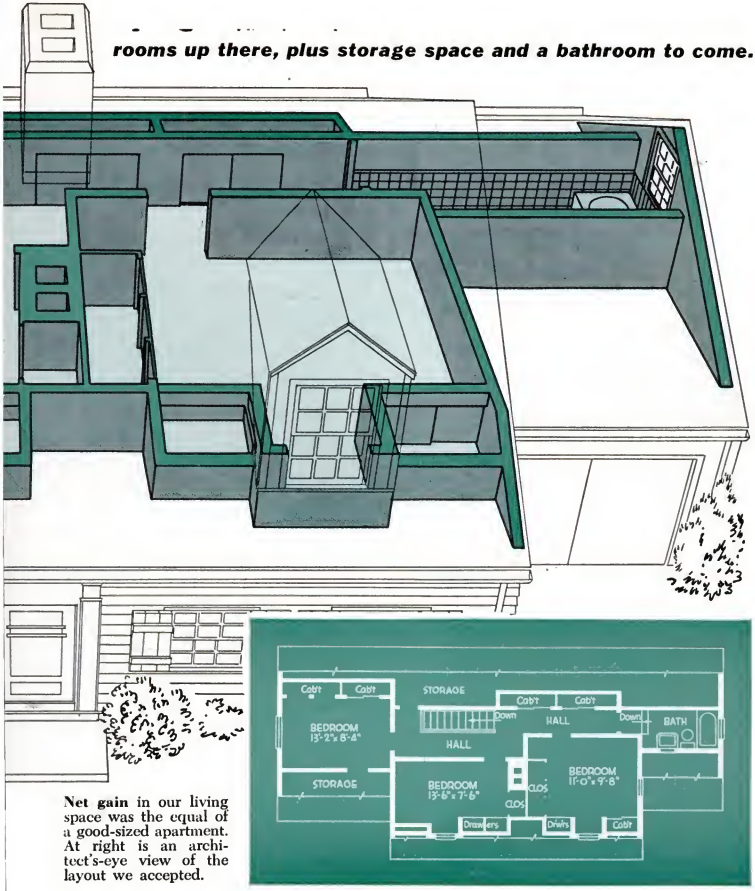
Although it seemed big to us, this was strictly a spare-time project, done evenings and week ends. We averaged three or four sessions a week, and never put in more than three hours in any one day.

How we began. When we bought the house, our attic was an echoing emptiness 25′ wide by 40′ long, under a low-pitched gable roof, with two small dormer windows. There was rock wool between the floor joists right over the ceiling lath, but no floor except for catwalks to the windows.

We broke down the entire job into these divisions: flooring, heating, plumbing, extra windows, insulation, partition walls, wiring, storage space, and doors. Immediately we decided that the bathroom would have to wait another year, since the plumbing was no job for amateurs (and forbidden by local codes), and the best estimate we would get was $881. Although called an expansion attic, ours had none of the necessary piping. This had to go in before the flooring, so we contracted with a plumber to install it.

Fortunately our present boiler (we have hot-water heat) was large enough to handle the increased load. Otherwise we would

rooms up there, plus storage space and a bathroom to come.



Net gain in our living space was the equal of a good-sized apartment. At right is an architect's-eye view of the layout we accepted.

have installed electric space heaters in each room. But these are costly to operate, and might have required new feed wires, so we were lucky to have an adequate heating plant.

Throughout our planning we sought to minimize or postpone expenses in order to lighten the load on an already tight family budget. For instance, when the heating pipes were installed, we had them capped. Thus we didn't have to buy radiators for six months, when we celebrated our grand opening by moving our little boy, Steve, into the north room. But while the plumber had the garage wall open to put in heating lines for the bathroom above, we had him install the hot- and cold-water pipes too, so that the wall won't have to be broken open

There wasn't much up there except space, to begin with. The steep roof pitch limited headroom, and rooms had to be planned to utilize what there was to the utmost. Only half the collar beams were in; we had to install the rest.

The dealer showed us how to stack flooring (which we brought in through a window) with scrap pieces between to let air circulate. This also kept the stuff from underfoot. If you walk on tongue-and-groove, edges break and the boards are then difficult to lay.

Catwalks laid to the dormers had to be torn up. The architect pointed out areas around windows and chimney where we had to set in two-by-four nailing members to support flooring adequately.

again next year when the fixtures go in.

With the pipes in, we were ready to start our own work. We planned to do everything except putting in extra windows and wiring. The windows could go in later, and the wiring had to wait until the studding was up. Before we tackled the job, we spent some time wandering through half-built houses and noting at firsthand how things were done.

Flooring was first. Our year-old son enjoyed crawling in the rock wool between the floor joists, and the lath ceiling beneath supported his weight nicely. Not so an adult's, as we found out when a friend stepped through it. Flooring was obviously first. We planned to put down a subfloor of 1″ tongue-and-groove and finish it with asphalt tile.

To avoid tightrope walking along or across the joists, we got several broad planks that we could lay around our working area. Then we started ripping up the catwalks, an onerous job because the stuff was toenailed through the tongue. It took six hours. But we saved the pieces, and later used them elsewhere.

When we were ready to buy our first 1″ by 6″ tongue-and-groove pine, we told the owner of the local lumber yard about our project. He was most helpful and agreed to give us a quantity price even if we took delivery of only a little footage at a time. We bought nearly 1,000 linear feet before we were done, but we didn't want to stack (or pay for) such an amount all at once. It took us over two months of spare evenings to lay the subfloor. This was the most monotonous part of the job, but luckily it came first, while we were fresh.

Nevertheless, we made our first mistake right there. Instead of ordering flooring, we should have gone to the lumber yard and selected the boards. Taking what was sent cost us many hours of extra labor to force warped boards into shape, and we had to cull out and set aside a needlessly large amount of split or warped footage. (Ironically, the best lot was the last, so the flooring under the eaves was the neatest we laid.)

We laid it straight. The experts and the books will tell you subflooring should be laid diagonally. Ours isn't. We found that diagonal subflooring is supposed to strengthen the house, but our house was hanging together nicely with no attic flooring at all, so we figured it would keep on doing so. Laying those boards diagonally

Two to nail flooring, and baby made three. A wedge of tongue-and-groove stock, driven between the piece we were laying and scrap nailed to the joists, enabled us to force even warped lengths into position. Close-up below shows the way we did it.

would have been a tough job for us, and would have cost us extra lumber.

Another departure was in our nailing method. There are those who can sink a nail cleanly into the tongue and get a faultless fit over it with the groove of the next piece, but it didn't work that way for us. We kept splitting the tongues. Finally we switched to 2½" cut nails, driven straight through the face of the flooring, two to each joist. These sank themselves without setting.

We started flooring under the front eaves with the old lumber we'd ripped from the catwalks. This area was planned to be storage space, which would not be covered with asphalt tile, and we preferred to use the better lumber as we worked out into the rooms proper.

The dealer from whom we bought the nails taught us our first trick. To force tongue-and-groove stock together, we used a scrap piece cut in the shape of a wedge. This was driven between the flooring and a piece nailed to the joist, the groove on the wedge fitting the tongue on the board.

We could lay two or three boards at a time this way if they were not badly warped, and could force almost any single board into place no matter how badly warped. Since time meant less to us than money, we saved short ends and knotted pieces for use under some of the eaves, so we wasted hardly any. Although it was easier to lay long boards, we sometimes cut them to minimize the warp. We tried to avoid making two adjacent joints on the same joist, as we were told this would tend to let the floor creak.

By using ⅜" plywood instead of pine boards, we could have had a superb subfloor much faster, with an ideal surface for laying the asphalt tile. But our budget said "no," because plywood would have cost us almost twice as much.

Enter the architect. It was while we were having our flooring troubles that POPULAR SCIENCE became interested in our project and offered to furnish us an architect, a luxury we hadn't dreamed of.

This took the shape of J. Conrad Breiby, Jr., six-feet-three of rising young architect, who told us we didn't have to lay the flooring right up to the plate. He suggested we leave an inch all around to allow for expansion. He also pointed out areas around

Partly laid, the flooring looked like this. To warm up for the job, we first built two sawhorses like the one shown. They were fun to make, cost about a dollar apiece, and proved indispensable. Ventilating louvers in end wall were replaced with a window later on.

the dormers and chimney where the joists were not placed properly to support the flooring, and at his suggestion we set in two-by-four nailing members there.

By the time we had finished the flooring, Mr. Breiby presented us with two sets of drawings. One showed us how the attic would look as we had planned to lay out the rooms, together with many niceties we might have overlooked. The other outlined a more ideal use of the space, but called for a twenty-foot shed dormer along the back wall. We didn't feel up to building that ourselves, and it would have cost more than $500 to have it done.

Let there be light. While sticking to our original plans, we nevertheless had to admit things looked dark away from the dormers. The best answer within our means seemed two ordinary windows in the ends of the attic—one in the bathroom-to-be, the other in the largest bedroom.

There was quite a debate about the installation of these windows, Mr. Breiby and the editors believing we could put them in ourselves, and we feeling that we probably could—but what if they leaked? Because of our misgivings, we finally hired a skilled carpenter, Walter Brandmeier, of Rye, N. Y. He not only put in the windows but gave us invaluable advice on other matters.

The helpfulness we encountered everywhere was perhaps our outstanding pleasure during the whole job. Everyone with whom we came in contact shared his knowledge, and many of the suggestions offered saved us hours and—more important—dollars.

For additional light, Mr. Breiby's plans show a good idea we haven't yet been able to afford—two tiny second-story windows of the hopper type similar to those used in cellars, placed in the end walls of the central portion where the garage and north wing are set back. These would admit a little light and afford cross ventilation. We plan to have these installed at some future date.

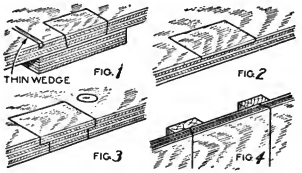
The architect also pointed out that there is room for a 24″ attic fan under the ridge peak at the south end of the house. Such a fan would boost air circulation on sultry days. We haven't bought the fan yet (and won't until summer) but we did leave a trap door through which it can be installed. A future article will describe the grilles we set into the ceiling of each attic room.

Next month Mrs. Goodman continues her story of an attic made livable.

Kitchen Detergents Clean Brushes

When I finish a paint job, I use this method of speedily and easily cleaning the brush. Put the brush in a clean jar or can. Place a heaping teaspoonful of a household detergent in the can. Add warm water to cover the bristles. Slosh the brush around in this mixture. Repeat with more detergent, if necessary. In a few minutes you'll have a clean brush.—*Robert W. Bradford, Syracuse, N. Y.*

PLYWOOD REPAIRS



When smoothing the surface of plywood is the only repair, clean the cavity, pack with plastic composition wood or similar filler, and sand level after drying. Two or three applications are best in deep holes.

If a saw can be used and there is opportunity to put in a backing block, saw out a piece and plug with a patch having tapered edges, as shown in Fig. 1. In many cases nails and screws can be used to reinforce the glue. Scratches can be routed and filled with wedge-shaped strips glued in and sanded flush.

Figure 2 shows a veneer patch suitable for bright finishes. Select a face veneer from plywood with a grain matching the work as closely as possible. Undercut the edges. Trace around it on the work, rout a little shallower than the veneer, and glue in the patch, scraping and sanding level when dry.

A shiplap patch for heavy plywood that can be chiseled out in steps is shown in Fig. 3. Also in Fig. 3 is a puncture patch made by boring through and inserting a plug made with a circle cutter or lathe.

When large areas are damaged, saw out the section and replace it, as in Fig. 4, reinforcing the beveled edge joints with battens behind.

FOR YOUR POPULAR SCIENCE INFORMATION FILE

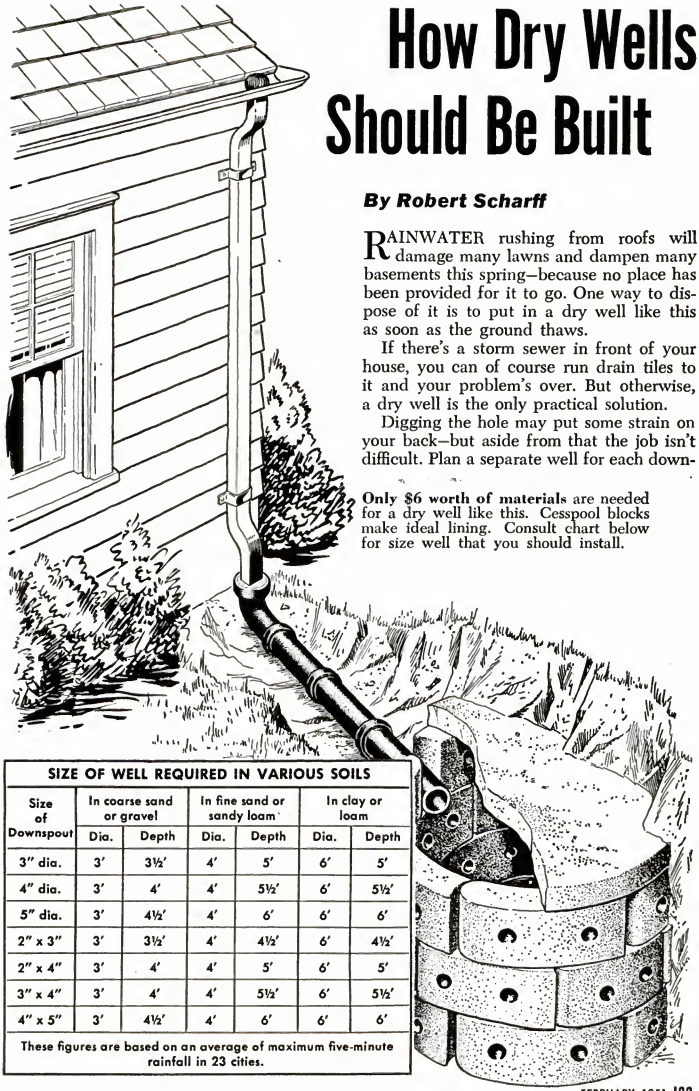
How Dry Wells Should Be Built

By Robert Scharff

RAINWATER rushing from roofs will damage many lawns and dampen many basements this spring—because no place has been provided for it to go. One way to dispose of it is to put in a dry well like this as soon as the ground thaws.

If there's a storm sewer in front of your house, you can of course run drain tiles to it and your problem's over. But otherwise, a dry well is the only practical solution.

Digging the hole may put some strain on your back—but aside from that the job isn't difficult. Plan a separate well for each down-



Only $6 worth of materials are needed for a dry well like this. Cesspool blocks make ideal lining. Consult chart below for size well that you should install.

SIZE OF WELL REQUIRED IN VARIOUS SOILS

Size of Downspout	In coarse sand or gravel		In fine sand or sandy loam		In clay or loam	
	Dia.	Depth	Dia.	Depth	Dia.	Depth
3" dia.	3'	3½'	4'	5'	6'	5'
4" dia.	3'	4'	4'	5½'	6'	5½'
5" dia.	3'	4½'	4'	6'	6'	6'
2" x 3"	3'	3½'	4'	4½'	6'	4½'
2" x 4"	3'	4'	4'	5'	6'	5'
3" x 4"	3'	4'	4'	5½'	6'	5½'
4" x 5"	3'	4½'	4'	6'	6'	6'

These figures are based on an average of maximum five-minute rainfall in 23 cities.

Dig the hole to a depth a little below house footing. Also make it deep enough to allow for at least 12″ of soil above the well cover.

Lay up the blocks in tongue and groove style, giving well a slight conical shape. Fill the space around the outside of well with sand.

Cement the tile joints, using mortar made of one part cement to three of fine sand. Pack oakum into bell before working in the mortar.

spout, and locate each eight or twelve feet from the house.

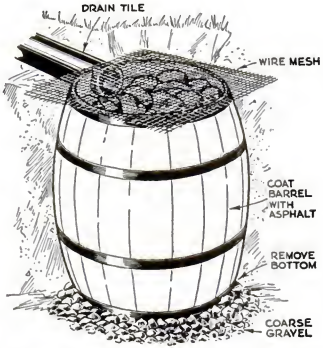
Line the hole with brick or cesspool block, laid up without cement. Water will then seep through the sides as well as the bottom. Cover the well with a slab of concrete or a cesspool cover.

Use terra-cotta drain tiles to carry water from the downspout, pitching them down about 1″ in each foot so the water will flow smoothly. If it's necessary to cut a tile, fill it with sand and cut with a cold chisel. The sand will keep the tile from cracking.

Before filling in the earth above the drain, try it out by letting water run through. If you find a low spot, raise the tiles there by wedging small stones under both sides. Put a wire cage at the top of the downspout to catch leaves.

For a less permanent type of well, see the drawing below. Sink the barrel into the ground about six feet, fill with gravel, connect the drain, put on a wire mesh or other cover, and shovel back the topsoil. This kind of well does a good job at first, but it eventually will clog up with leaves and other debris and become useless.

It's a good idea to connect the drainage of an automatic washer to a dry well. Thus you reduce the load placed on a regular cesspool or septic tank. Water from the roof, incidentally, never should be carried to a cesspool or septic tank. If filled with rain water, such containers can't take care of household sewage. END

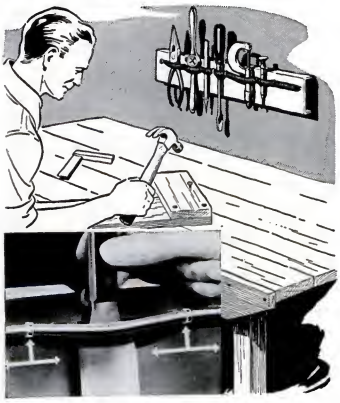


A dry well of temporary type can be made by removing bottom from barrel or oil drum, covering with asphalt, and sinking it in ground.

Level in Extension Does Double Duty

You can save the expense of two levels by nesting one in an extension frame. The photos show a 2′ level in a 4′ frame. I used a redwood two-by-four, making the lengthwise inside cuts on a circular saw and the cross cuts with a coping saw. Pieces of ⅛″ plywood glued to the back of the frame at each end and two screw-fastened metal strips on the front keep the level in place.—*W. G. Waggoner, Sacramento, Calif.*

Spring Holds Tools on Rack



The eight sliding ring clips on this rack can be moved to left or right to make the holding spaces the correct sizes to take various tools. The clips slide in a series of slots behind the spring. The 18″ rack is sold by Hobby Hill, Chicago.

Clips Hold Pages in Notebook

Two small spring-type clips placed on the rings of a loose-leaf notebook are convenient for holding magazine pages, drawings, photographs, and other material that you may wish to file with your notes. Material kept in this manner need not be punched.—*John J. Rea, Urbana, Ill.*

Countersink Heads Over Tubular Rivets

If you don't have a tool for peening tubular rivets, try a countersink. Insert the countersink in the end of the rivet and strike the countersink with a hammer.—*William B. Eagan, Louisville, Ky.*

Clamp Helps in Sawing Plywood

Sawing a wide piece of plywood or composition board is a lot easier if you'll use a small C clamp. After you make the saw cut deep enough to attach the clamp as shown at right, you can complete the cut without binding.—*Joel Miles, Denver.*

Rubber Kit Checks Vibrations

Much of the noise and shock produced by machinery can be muffled with a rubber mounting kit sold by the B. F. Goodrich Co., of Akron, Ohio. The kit includes a 12″ by 12″ rubber pad, rubber tubes, and washer-shaped rubber snubbers. Pieces of the pad are cut to size and sandwiched between ⅜″ steel plates. Pieces of the rubber tube are cut to fit around the machine's hold-down bolts. The snubber goes over the top of the bolt and is followed by a washer and nut.

What You Should Know About Paint Removers

Flow remover on with fully loaded brush, using flat of brush (left). Brush in one direction only, not back and forth. A couple of applications may be needed to remove all the old paint. Work only a small area at a time since remover dries fairly fast. When paint surface is soft or wrinkled (center), scrape it up with a dull putty knife, being careful not to scar the wood. Pour on more remover after paint has been removed and rub surface with No. 0 steel wool (right). This leaves the surface satiny smooth. Then wipe surface with rag and turpentine.

Stand leg of furniture (left) in bucket to catch excess remover and prevent runs onto floor. Semi-paste removers are better for vertical surfaces than liquid removers.

Wear goggles to protect your eyes when using remover on overhead work (right). Also wear them when brushing softened paint out of carvings. Brushing may splatter remover.

Scrape softened paint out of grooves or carvings with old toothbrush (below). Other tools that help in tight spots are a stiff-bristled brush, pointed sticks, and cotton waste.

Use new, special remover (below) to take wax, varnish, or shellac off floors and stairs. Flow it on, scrub with No. 3 steel wool, and scrape up dissolved finish with squeegee.

Fast acting removers—based on powerful chemical solvents—are especially designed for their jobs.

By Bernard Gladstone

PS PHOTOS BY W. W. MORRIS

TAKING the old finish off furniture or woodwork needn't be a messy job—if you go about it right with the right remover.

Before the manufacture of solvent-base removers, the only kinds available were the alkaline types. These still are used in industry, but the commercially prepared removers are better for the handyman. They are easy to handle and they won't attack flesh and clothing like the corrosive, alkali types.

Kinds of Removers

Today's removers can be divided into two major types—those that contain wax and those that don't. The non-wax type is available in both flammable and nonflammable removers. The wax type can be obtained as either a liquid or a semi-paste.

The liquid removers are best suited for use on horizontal surfaces such as table and desk tops. The creamy, semi-paste removers work better on vertical and overhead surfaces like door frames since they are not as likely to run and streak as are the liquid removers.

Removing Waxy Residue

Removers that contain paraffin to slow up evaporation of the solvent leave a waxy residue that must be taken off after you've finished removing the paint. A new finish will not dry and properly adhere to a waxy surface. Wiping the surface with a rag soaked in benzene or alcohol will remove the wax.

Removers that don't leave a waxy residue usually contain such chemicals as cellulose acetate or ethyl cellulose to retard evaporation instead of wax. Generally speaking, these are more expensive and slower acting than the wax type.

Nonflammable removers also are slower acting than the flammable type, but their safety characteristics make them less danger-

ous for use in a cellar shop. If you use a flammable type, be sure to keep far away from any open flame. A typical flammable remover is made up of three parts of paraffin dissolved in 50 parts of benzol to which is added 25 parts of denatured alcohol and 25 parts of acetone. *Don't take chances!*

Don't forget, too, that the commercially prepared removers of any type can be dangerous in a poorly ventilated shop. Their vapors may make you extremely ill. Work outdoors if you can. If you must work indoors, watch the ventilation.

Special Removers for Floors

When you want to remove wax, varnish, or shellac from a floor, use one of the new solvents made especially for this purpose. They are not very effective on paint, but they act fast on clear finishes.

These removers leave the floor bare and clean. No after-rinse is required, and you don't have to use a filler on the floor before refinishing. Just let the floor dry and it's ready for the new finish.

This kind of remover also is excellent for cleaning accumulations of wax and dirt from inlaid linoleum.

Applying Paint Remover

Removing paint takes a little more work. After you brush on the remover (use an old brush), let it stand until the paint is soft. Don't be impatient. Give the remover time to work. When the paint is soft, scrape it off with steel wool or a putty knife.

You might run into a tough layer of old paint that doesn't soften up with the first coat of paint remover. In such a case, just continue to apply remover. Sooner or later the remover will soften even the hardest paint.

If you use a dull putty knife (as shown in a photo on the first page of this article), scrape carefully with the grain. The U. S. Bureau of Standards recommends using a sharp putty knife held vertically and scraped across the grain.

Heat Removes Old Paint

Painters frequently remove old, scaled, and cracked paint from the exterior of a wooden house by burning the paint with a blowtorch. The flame softens the paint so it can be scraped off. If you use this method, be careful. A fire hazard exists.

A small electric burner that softens and peels paint away is on the market. This tool is slow, and it works best on flat surfaces.

A 250-watt infrared lamp will also soften paint so it can be scraped off. Hold the lamp three or four inches from the surface until the old paint is soft.

Corrosive Removers

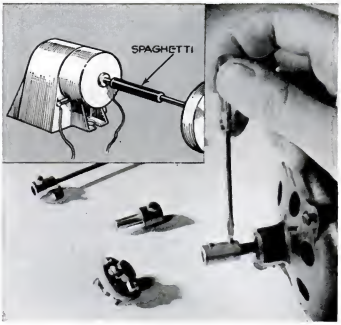
These are sodium compounds—such as caustic soda, soda ash, washing soda, or trisodium phosphate—dissolved in water. They are used boiling hot and are good on iron or steel, particularly where the work can be dunked in the solution. They should not be used on nonferrous metals such as aluminum, zinc, or brass.

Corrosive Removers Harm Wood

Alkaline removers will take the paint off wood, but they darken most woods. Also, all trace of these solutions must be cleaned off the work after the paint has been removed. Any remover left on the work is likely to destroy the new finish.

These corrosive solutions are extremely dangerous. They attack skin and clothing viciously. When using them, rubber gloves should be worn. END

Radio Parts Fit Model Motors



If you need fittings for small motors, try the radio store. You'll find a large assortment of good modelmaker's accessories. Practically all tuning condensers and volume controls have ¼″ shafts. The couplings made to fit them can also be used to link ¼″ motor shafts to models, toys, and small machines. The photo shows four of the many available types of couplings, extenders, and flexible drives. For small motors, "spaghetti" insulation can serve the same purpose.

Lazy Suzan Rolls on Awning Pulleys

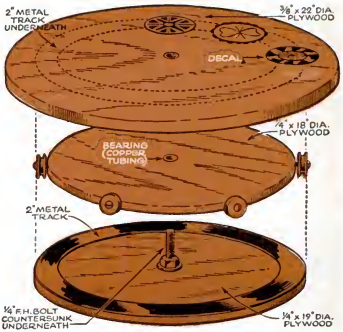
Centered on table, at right, it holds all the serving dishes for a meal. Designs are Pennsylvania German.

LAZY Susans are recovering some of the popularity they enjoyed a hundred years ago. Here's one you can make quickly.

For the rollers, remove the wheels from four or six awning pulleys. These wheels are turned true, have a diameter of about ½", and have a center hole a little larger than ⅛". Attach them to the center disk with roundhead wood screws. Drill holes in the edges of the disk for the screws.

Cement or tack a sheet-metal track around the outer edge of the base and under the top deck for the rollers. Sheet aluminum will give quiet operation.

Apply a sealer and two coats of enamel, sanding between coats. After putting on your decorations, spray a coat of transparent plastic on the top deck. This protects the surface from heat and liquids.—*Harold McIlvaine, Moscow, Idaho.*



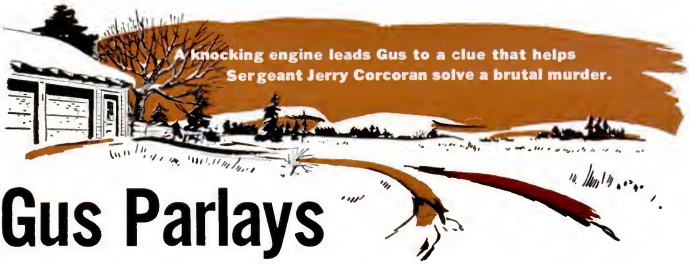
Mount at least six rollers around the center disk to give stability to Susan of this size.

Kit Makes Oil Painting Easy

HAVE you always wanted to be a Rembrandt? And do you always turn out daubs? With this kit, says the manufacturer, the amateur can hardly go wrong. Sold by the Picture Craft Co., Decatur, Ill., for $2.95, a 12- by 16-inch canvas is already sketched in with all areas numbered. Ready-mixed paints in vials are correspondingly numbered. An art brush is included.

Drafting Pencils Pointed Electrically

A DRAFTSMAN can get just the point he needs on his lead with this electric sharpener that can be clamped directly to the drawing board. A mechanical lead holder is inserted into the hole on top, and the curved lever set to any of five desired pencil-point shapes. The unit is made by the Rajean Manufacturing Co., Racine, Wisconsin.



A knocking engine leads Gus to a clue that helps Sergeant Jerry Corcoran solve a brutal murder.

Gus Parlays a Pair of Hunches

By Martin Bunn

GUS Wilson, sitting at his desk in the Model Garage office, glanced at the local newspaper Stan Hicks had brought, and stopped sipping his midmorning coffee. A bold, black headline streamered across the top of the front page: FARM COUPLE FOUND MURDERED.

The story went on to tell how old man Bowen and his wife, both of whom Gus had known fairly well, had been murdered and

robbed the night before at their farm not far from town. A hired hand had discovered the crime when he returned from the movies at about 10:30 and had notified the State Police. By 11:45, three suspects had been rounded up and were being held for questioning. The story also said that the Bowens' 25-year-old daughter, Elaine, blind since birth, was in a hospital down in the city awaiting a series of operations that might restore her sight.

As Gus re-read the news account, he heard the repair-shop door open and close. Sergeant Jerry Corcoran of the State Police came in, stamping his feet to knock the snow off his boots.

"What are you doing here, Jerry?" Gus called through the open office door. "According to the papers, you fellows have a double murder on your hands."

"Plus a robbery," grumbled Jerry. "And things aren't going any too easy either."

"Cup of coffee?" Gus asked.

"I sure could use one," Jerry agreed, unbuttoning his heavy coat. "I haven't been to bed yet."

When the trooper had poured himself a steaming cup of brew and settled on one corner of the desk Gus asked, "When do you suppose this thing happened?"

"That's one thing we do know," explained Jerry. "As near as we can reconstruct it, the old man got it first in the kitchen. Evidently there was a struggle and the cord of the electric clock got pulled out. It was stopped at exactly one minute after 10. Then it looks like his wife got hers trying to stop the robbers from making their getaway. Her body was in the snow outside the front door beside the driveway. Cause of death in both cases: bashed-in skulls."

"Did the murderers get much?" asked Gus.

"Don't know yet, but unfortunately the Bowens, like too many old farmers, didn't believe in banks or bonds. The rumor is that everything they had, which could have been plenty, was hidden in the cellar. Those

Gus's crawl under the car was brief—but had given him an idea. "Hold the fort awhile," he told Stan. "I want to see Jerry over at the police barracks."

operations they had arranged for their daughter were to cost several thousand, so there must have been at least that much."

"How about these suspects?" asked Gus, pointing to the newspaper.

"Three young punks from the city," replied Jerry. "One of our road blocks gathered them in about 15 miles out of town."

Gus poured himself another cup of coffee. "Got enough to hang it on 'em?"

"Not yet. For one thing we didn't find any money on them or in their car, and they've an alibi we haven't been able to break yet."

"What's their story?" asked Gus.

"Well, if you remember, it stopped snowing last night at about 9:45, so when we got to the Bowen farm the snow on that back road was still fresh. There was just one set of tracks, made by V-type tread snow-and-mud tires, the same kind of tires we found on the suspects' car, in and out of the driveway. The Vs in the snow showed that the car had entered the drive-around from the south—that's from the town side—and left toward the north. We followed the tracks up the back road for quite a distance."

Gus nodded.

Suspects Have an Alibi

"So far, so good. Now comes the fly," Jerry continued. "Sam Trayton, who runs that all-night eatery on the main road near town, says the men we're holding stopped at his place at about 10:25."

"I don't follow you," interrupted Gus.

"Okay, let's look at the facts. We are sure that the murders were committed at about 10 o'clock. Tire marks show that the murder car sped off to the north. Yet, Trayton, who certainly has no ax to grind, says the suspects were in his place, which is south of the Bowen farm, twenty minutes later."

"Did you . . . ," started Gus.

"Yes, we did," finished Jerry. "And we found that it takes a good 20 minutes to drive south from the Bowen farm to Trayton's, so they couldn't possibly have driven north and doubled back by way of the main road—an extra 10 miles—and made it by 10:25."

"Found the murder weapon yet?"

"Nope," replied Jerry. "That's another hitch. And I'm not helping to find it sitting here jawing with you," he added, buttoning his coat.

"And I'm not solving my mystery, either," put in Gus.

"Your mystery?"

"Yeah, the mystery of the engine that knocks when it shouldn't," explained Gus, jerking his thumb toward a coupe on the repair-shop floor. "Regular customer brought it in this morning. Claims his motor only knocks when you start it, stop it, or idle it. Runs perfectly otherwise. Swears there's no knock at all under a load."

"Well, I hope you have better luck with your mystery than I've had with mine so far," Jerry grumbled as he walked toward the shop doors.

Gus Tackles His Mystery

Gus soon forgot about Jerry Corcoran's troubles when he got down to digging into his own. Gus started and stopped the engine with the mysterious knock. He idled it. He gunned it. The customer had been right. The engine ran smoothly and without a sign of a knock at high speed, but grumbled when it was idled, just after it was started, or when the ignition was turned off. When the knock was there, it sounded just like a bearing that was shot.

Stan, who'd been smoothing out the wrinkles in a fender on another car, came over to where Gus was working. He got a kick out of watching the old mechanic methodically discard one possibility after another when he was tracking down motor troubles.

"Got you stumped?" he asked with a grin.

"Not yet it hasn't," Gus grunted, walking over to his bench and picking up a long-handled screw driver. "I've a hunch this 'knock' isn't a knock at all."

Using the shank of the screwdriver as a connector, Gus proceeded to short out each of the spark plugs in turn, while the engine was idling—and knocking. The knock persisted, which was almost a sure sign that it wasn't a bearing knock.

As Stan watched, Gus rolled his creeper

[Continued on page 242]

Homemade Tools from Old Auto Valves

Garages have these to give away. Take home a handful, and you'll find plenty of uses for them.

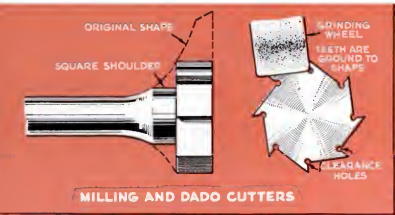
YOU'D find it hard to buy steel as good as you can get free in old auto valves. Most garages will give them to you.

Test the stem and the head with a fine file. Valves vary in hardness. You may get some the file will cut, but most are glass hard. Unless you plan to shape them entirely by grinding, these have to be annealed.

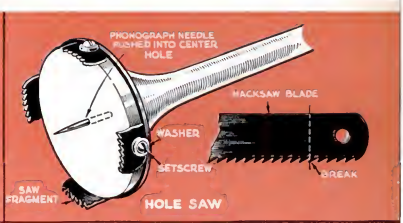
Heat the valve cherry red and immediately bury it in ashes to let it cool slowly. Some alloys don't respond readily to annealing, but since the valves cost nothing, you can discard stubborn ones or grind them.

The stems make good shafts or pins. By grinding, or turning and filing, you can shape them into punches, countersinks, and other tools. Reharden annealed metal by heating it to bright redness and quenching in oil. Then polish with emery cloth and reheat to temper the steel, judging hardness by the flow of colors.

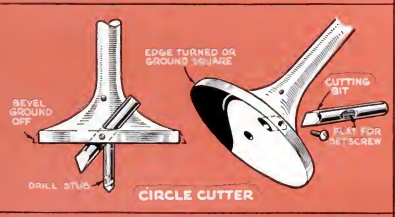
Valves are almost made to order for drill-press accessories, though you may want to cut the shank off to convenient chuck-



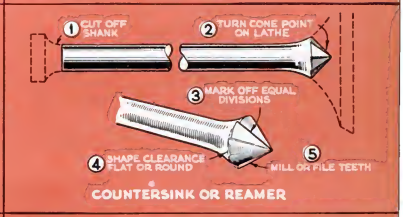
MILLING AND DADO CUTTERS



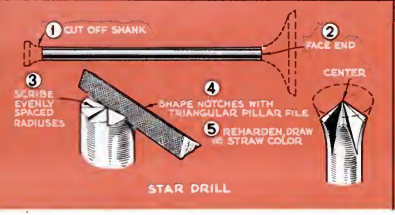
HOLE SAW



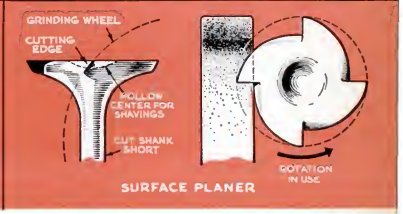
CIRCLE CUTTER



COUNTERSINK OR REAMER



STAR DRILL



SURFACE PLANER

Rotary planer can be made from any valve. One with hollow head provides ready-made chip clearance. Edges must be sharp to rim.

Buffing mandrel is made by tapping center hole in valve head to suit screw to hold on buffing wheel. Use big washer under the screw.

ing length, or get rid of a flared stem end.

Surface planer. Mark off equal spaces and grind four cutting edges as shown in the drawing. Finish by mounting in the drill press and lowering the head gently against a flat oil stone to lap all edges true.

Disk sander. Drill two holes 180° apart and file them counterclockwise (as seen from the stem side) to keyhole slots. Saw a 3″ disk out of plywood. Turn in two wood screws so they catch firmly in slots.

Hole saw. A large valve from a truck, airplane, or boat engine is probably best. After annealing, chuck the valve in a lathe and drill a center hole into which a phonograph needle will just fit. Turn the head to diameter, with a shoulder as shown. Drill and tap three or four radial holes.

Break off the ends of old hacksaw blades (the end teeth will still be sharp). Mount them with bolts and washers. Insert the phonograph needle to align the saw with a mark on the work. Clamp work on the drill press, remove needle, and make the hole.

Sander pad snaps onto valve with keyhole slots filed in head. Cement sponge rubber to pad; attach abrasive paper with rubber cement.

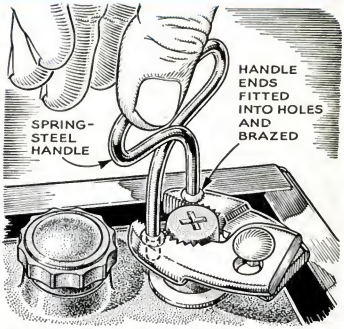
Circle cutter. Drill a 3/16″ hole in a valve head at a 45° angle, at the radius of the circle to be cut. Drill and tap a hole for a setscrew, preferably the hollow-head kind. Use a phonograph needle to center the cutter or, better still, set in a small drill held with a second setscrew under the head. The bit can be ground from 3/16″ drill rod. Clamp the work firmly on wood backing.

Dado and milling cutters. Turn the flare under the head to leave the edge the desired thickness. Index for teeth and drill a hole at the bottom of each. File or grind, reharden, and draw to a deep straw.

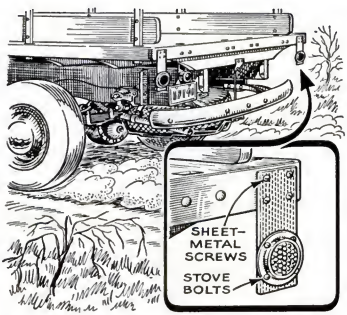
Star drills and reamers. The flare at either end can be used to advantage. Teeth can be ground with a wheel in a flexible shaft or hand grinder, if you don't wish to anneal the stock. For accuracy, reamers should be turned to shape and rehardened afterward.—S. *Palestrant, The Bronx, N.Y.*

Hints from the Model Garage

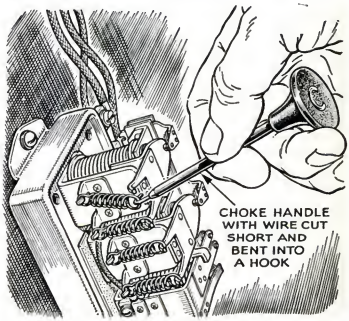
White Paint Shows Brace Slot. In the dark it's often difficult to prop up your hood with a swinging brace because you can't see the slot. Applying a little white paint around the slot will make it stand out prominently even in poor light.



Altered Pliers Clean Battery Post. To make this handy tool, cut the handles from an old pair of pliers, drill two holes, and braze in a spring-steel handle. Slip the jaws over the post, rotate a few times, and the post will be thoroughly cleaned.



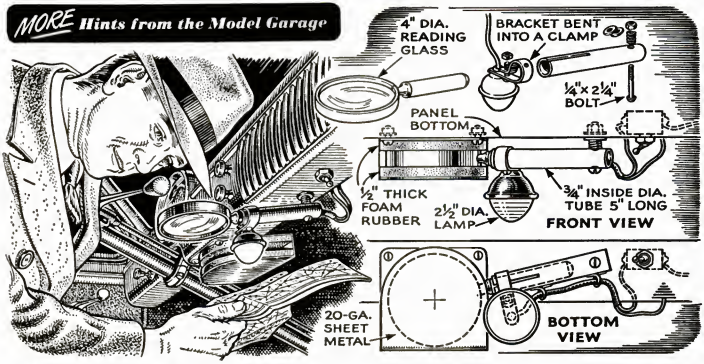
Swinging Reflectors Escape Damage. If you should back your truck into an obstacle, flexibly mounted reflectors will swing under the truck bed without damage. Bolt each reflector to a piece of canvas belting about 12″ long and attach the other end of the canvas to the truck bed with nails or self-tapping metal screws.



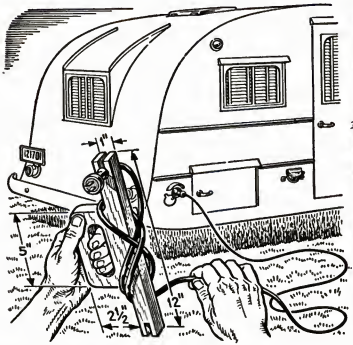
Choke Handle Is Spring Tool. Here's an easily made tool that Marion L. Rhodes finds handy around his shop in Knightstown, Ind. It's just the thing to hook on or off the small springs in a current and voltage regulator. Carburetor and generator springs are other possible uses. The wire is stiff enough to retain its hook shape.

Turn the page, please, for three more auto hints.

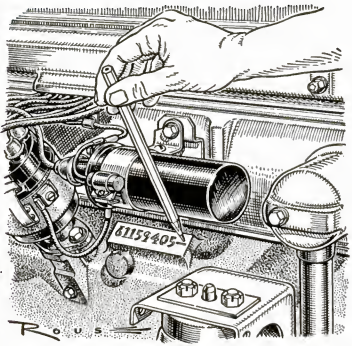
MORE Hints from the Model Garage



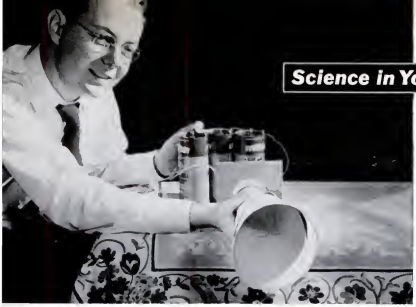
Glass Magnifies Map Details. A large reading glass mounted under the dash like this will help you see fine print on a highway map. Supported on a pivot, the glass swings into a pocket lined with foam rubber while not in use. This protects the lens and keeps it clean. A truck clearance lamp clamped to the swinging arm throws light on the map. A lead can be run to the hot side of the ignition switch. For some cars you'll have to vary the setup to suit a different kind of instrument panel.



Reel Stores Extension Cord. House trailers are often equipped with 115-volt electric wiring circuits, but to bring current into the trailer a long and unwieldy extension cord is required. To simplify handling the cord, A. V. Malone, of Los Angeles, designed this carrier. Wind the cord as shown, each revolution forming a figure eight. The 1" slots at each end are for hooking the plugs to the carrier.



Did You Know This? A ¼" dash stamped after an engine number means that all the cylinder bores were finished .010" oversize at the factory and are equipped with .010" oversize pistons and rings. You must take this into account in overhauling such an engine. Motor makers commonly finish all bores this much oversize if one is too large for finishing to nominal size. However, such engines are not considered special.



Here's a working model of electric horn. Photos below show how it was built. Cone projects sound like trumpet on real horn.

Science in Your Car

How Auto Horns Work

What happens when you press the button? You'll see quickly if you make these simple working models.

By Kenneth M. Swezey

THE makers of auto horns have come as far from their early baa-DOO-gah! days as have their brother engine designers. So if the horn on your new car both sounds better and carries farther, it's no accident.

Some horn developments have been purely technical, but others have turned upon the physics of sound. Designers have found, for instance, that pitch is more important than loudness (amplitude) in achieving carrying power, and that loud sounds aren't so unpleasant if they have a musical tone.

Next to fire-engine sirens, the most powerful horns today are the air-blown trumpets used on cross-country trucks and busses and as custom accessories for passenger cars. They work like trumpets in a band, with vibrating reeds or diaphragms taking the place of players' lips.

Magnetically actuated, vibrating-diaphragm electric horns are standard on most passenger cars. They work like household buzzers. The vibrating part is connected by a rod to a thin metal diaphragm.

Horn makers also produce whistles that operate from the exhaust, and air and electric horns on which you can play tunes.

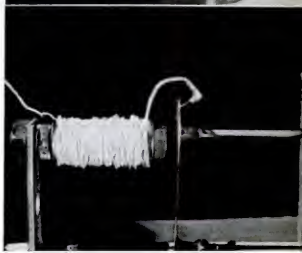
You can see how the various kinds of horns work by performing the experiments below and on the next two pages.

ELECTRIC HORN

You can make a working model like the one above in a few minutes. Its magnet is a bolt wound with insulated copper wire. Mount this on an angle bracket.

The L-shaped armature is bent from a strip of tin. The diaphragm is a disk of stiff paper glued at the edge over a smaller hole cut in a piece of corrugated cardboard. Link the diaphragm and armature by a matchstick secured at each end with a drop of sealing wax. The current-breaking contact is formed by the bare tip of one end of the magnet wire that just touches the far side of the armature when the battery is off.

When you connect the free end of the magnet winding to one pole of your battery and the base of the armature to the other, current flows through the coil. The coil becomes magnetized and pulls the armature toward it. This breaks the circuit between armature and contact point, causing the armature to spring back again—only to be once more attracted. The sound of the vibrating armature is increased by the paper diaphragm attached to it. Tone and intensity can be adjusted slightly by changing the pressure on the contact wire. A cardboard cone held against the diaphragm will make the sound louder.



AIR HORN This variety produces a sound in much the same way that a tin horn or your vocal cords do. The old honk-honking horns depended upon a thin metal reed that vibrated strongly when you squeezed the bulb. Some present-day musical horns work on the same principle. More powerful air horns depend upon the vibration of a diaphragm against the end of a trumpet.

You can make a workable vibrating-reed horn from a soda straw. Flatten one end and cut about ¼″ from each corner as shown in the diagram. Put about 2″ of this end into your mouth. Then blow. Shorten the straw and you will raise the pitch. Add funnels of different sizes and shapes over the end of the straw and you will change and magnify the sound just as trumpets do on a real horn.

KLAXON Horns of this famous type make their OOgah sound when a studded wheel rotates against a projection on the back of a diaphragm. The wheel is turned by an electric motor or by hand through a train of gears. Pitch is changed by varying the wheel speed. You can make a model by cementing a thumbtack to the center of the bottom of an empty salt box, and rubbing a file over the point.

WHISTLE Whistle-type horns work like an organ pipe. A blast of air passes over a sharp edge near one end of a metal pipe. The turbulent air at the edge starts the air in the pipe vibrating at its own natural frequency, determined by the length of the pipe. You can test this principle with soda straws and bottles, as below. Combination tones can be produced by blowing over several bottles of different sizes at once.

SIREN Now often restricted to fire engines, ambulances, police cars, and air-raid warnings, a siren produces its characteristic scream by intermittent puffs of air issuing through holes in a revolving drum or disk. A simple model will show how it works.

Punch a circle of equally spaced holes near the edge of a coffee-can cover. Mount the cover on the shaft of a small grindstone or fasten it in the chuck of a hand drill. Blow through the holes with a straw, flattened at the nozzle end, as you turn the disk. The harder you blow, the louder; the faster you turn, the higher the pitch.

Commercial sirens usually consist of a metal drum with slots in the periphery. This revolves inside a slotted stationary drum. A fan attached to the rotating drum sucks in air at the axis and hurls it out the slots.

How sound waves are intensified by the use of a trumpet can be shown visually with a candle and a tin can. Remove the top from the can, hold the top a little more than the can's length from the candle, and snap the top with your finger. The candle doesn't flicker. Now hold the mouth of the empty can near the candle, and snap the bottom of it. This time the sound waves, aimed by the can, disturb the candle flame noticeably. END

Taking the Sag Out of Garage Doors

Why struggle with them any longer? They will swing freely and last longer if you mend them now.

By Harry Walton

GARAGE doors fall roughly into three categories: those you can open easily, those you can drag open with a small tractor, and those you have to blast.

If you have type two or three, you won't need to be convinced that repairs are in order. Were they just beginning to drag last fall? Then the chances are a winter of scraping them over ice and snow hasn't improved their condition or your temper.

The earliest good outdoor-working weather is none too soon to fix ailing doors and to protect them against further damage from spring rains.

Where's the trouble? The first thing to determine is whether it's actually the doors that are sagging, or whether they drag because frost has caused the concrete apron to heave until it scrapes the bottoms of the doors. If the door joints are sound, the frames square, and the hinges securely attached, the apron is probably at fault. The obvious cure is to cut half an inch off the bottom edges of the doors. You can do that without taking the doors down, at the cost of considerable elbow grease and back bending.

More often, the trouble is in the doors themselves. Hinge screws rust and pull loose. Joints rot through and open, particularly at the top of the frames, allowing the outer stiles to drop until the whole frame gets out of square and drags.

Prop it up first. As soon as you've determined where the trouble is, decide whether the door should be wedged up or braced to realign displaced members. It's of little use to tighten a hinge permanently in the same position that allows the door to drag. Don't depend on the hinge screws to lift heavy doors back into place. Give them an assist with wedges or props, as shown in the photos.

Tightening the hinges. If hinge screws have pulled loose from the jamb or rusted out, slightly heavier ones may find anchorage in the old holes. It's better, though, to plug the holes with pieces of dowel, glued in. Or, if the inner face of the jamb is exposed, you can forget about wood screws. Drill right through the old holes and insert flathead bolts, with washers and nuts on the inside of the jamb.

A badly split or rotten jamb will have to be replaced, but where the damage is only under the hinge leaf, you may be able

What happens when doors are frequently left open is shown below. Rain soaks into joints at top edge. The rail tenon pulls loose, and so do the hinge screws, letting the joint open. The sagging door drags the hinge askew.

To lift sagging bottom corner, drive in wedges like this. If open top joint doesn't draw together, close the door and drive wedges again. Then insert long prop between the open joint and opposite jamb (above). This will close the joint, but be sure to wedge up the stile too.

Wood screws in this hinge leaf had rusted loose, leaving holes too enlarged even for bigger screws. Glue was first worked into the open joint. Then the joint was closed with a brace (top right photo). New holes were next drilled right through hinge and rail (left). Flathead bolts were inserted, and the nuts were tightened over washers on the inside of the rail. Then a metal mending plate was put on the inside of the door to help hold the joint together.

Broken joint was clamped as shown to align the faces, the stile being raised by a wedge at the bottom. Then holes were bored, and hardwood dowels, coated with glue, were driven in.

Dowel-repaired joint was reinforced with a batten. Paint was scraped off the door to give glue a good grip, batten was clamped in position, and holes were drilled through. Batten was bolted below rail edge to clear door stop.

Right-angle mending plate, mounted with wood screws or through bolts, is another means of tying together a re-glued joint. Use the biggest plate you can. A second plate inside the door can be held by the same bolts.

to move the hinge up or down into sound territory. If this isn't practical, consider bridging the bad section with a long piece set against the inner face of the jamb. You'll need bolts long enough to go through the jamb and the new piece.

Hinge screws are even more likely to pull loose on the door, which is more exposed to weather than the jamb. Here again you can drill the holes clear through, and use bolts instead of wood screws. Be sure to put washers under the nuts.

Sometimes the wood around screw holes is soft with rot, and even washers and nuts find no solid anchorage. Short of moving the hinge (which is sometimes impossible because the top rail isn't wide enough) your best bet is to drill new holes in other parts of the hinge leaf, away from the old ones.

Pulling joints together. Garage doors stand open so much that rain eventually enters the joints between the stiles. Even paint offers only short-term protection here. Eventually the water-soaked wood rots and the joint disintegrates. It pays, therefore, to make repairs before this happens.

If the tenon is loose in its socket but the wood is still sound, glue and dowels may suffice to hold it together. Work water-resistant glue well into the joint with a knife blade or spatula. Then wedge the bottom of the door or put a prop against it from the farther jamb, watching the joint to see whether it closes. Bore holes across the joint (from the front to the back of the door) and drive in dowels smeared with glue.

The wood may be so rotten that the tenon has broken off the rail. The photos show several ways of repairing such a joint. Dowels driven in from the end will align the faces, but can't be relied on to hold the joint together by themselves. Add wooden or metal mending plates.

Hold that shape. It's well to give weakened joints some support by tying the bottom outer corner to the top of the hinge stile with a brace of some kind. It may be the conventional turnbuckle support shown in the photos, or a batten fastened on diagonally. Use husky wood screws, preferably brass, galvanized, or cadmium plated, to hold on a batten.

A very substantial brace consists of a panel of plywood screwed (not nailed) to the door below the window area. You can get two pieces (enough for both doors) from a standard 4 by 8 panel. Buy the ⅜″ sheathing grade instead of the more costly

That old standby, the turnbuckle stay, will help pull doors back into shape. If you already have stays, they may merely need tightening. In putting on new ones, remember to match the left- and right-hand threads on rods and eye.

Plywood bracing panel can be attached with 1¼" wood screws 6" apart. Glue applied to inner face all around edge adds strength and resists entrance of water. Paint plywood promptly after installation, especially along edges.

kind. Paint it well, and keep it painted.

Rainproofing the doors. Any wooden structure must be kept painted to withstand the weather. It pays to repaint garage doors promptly when they need it, and to use a top-quality outdoor paint. Cracks can be filled with putty or weatherproof glue.

The vulnerable top edges of the doors need special attention. The best protection is a copper or galvanized sheet-metal cap, that you can bend up from a strip or have made at any tinsmith shop. Coat the inside of the cap and the top of the door liberally with roofing cement. Drive nails in through the down-bent sides only, not in the top, to hold the cap on. END

Water caps are worth installing, even on old doors. Installed on new doors, they'll save you lots of headaches. End grain on stiles takes paint poorly and consequently soaks up water that leads to rotting. Cap can be bent from sheet metal. Smear thick layer of roofing cement on top of door and then put on cap. Drive nails through sides of cap, not through top. Bend out edge of cap, if necessary, to divert water from mending batten.

Winter Evening Craft Projects

Tired of taking your leisure sitting down? Too early to get outdoors? The home workshop is the ideal place to spend these long winter evenings. While you're about it, why not try something different? These two projects may take you down a new road, if you've never tried metalworking or wood carving before. They're absorbing to make and nice to have —or to receive as gifts.

Barrow frame is bent into V shape. Legs, formed from one length of square brass, are held on with black iron wire for soldering.

Wheelbarrow Planter. Brass is the ideal material, but if you paint the piece even tin plate will serve. Bessemer rod is a fair substitute for the ⅛″ rod, and radio bus bar for the decorative twist.

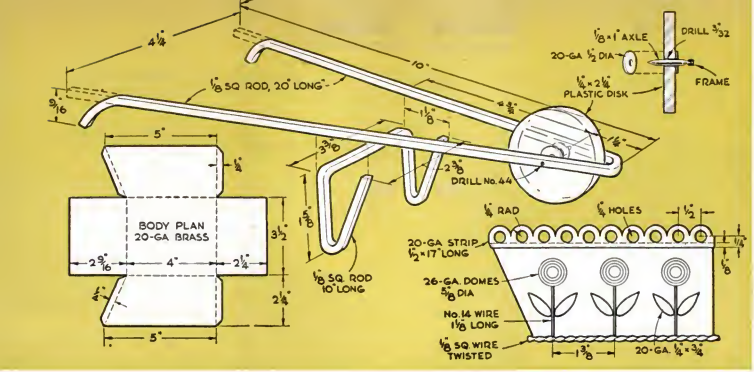
Bend a 20″ length of ⅛″ rod into a V, and a 10″ length into a pair of legs joined by a crosspiece. Bevel the ends to fit the frame, wire on, and solder.

Drill a No. 44 hole through the frame near the front. Cut a plastic wheel with a 3/32″ hole in it. File points on a piece of ⅛″ round rod, heat to about soldering temperature, and carefully push it halfway through the disk. Hold it perfectly square until it's cool.

Form the tire from a ¼″ wide strip of

Twisted edging is made by clamping one end of annealed square brass in a vise and locking the other in a T-handled tap wrench. Turn to a tight spiral. Cut off and discard ends.

A dapping die and punch rapidly turn out domes for the decorative pattern. The 26-gauge copper must be annealed at least twice. Wood block and round punch will also make domes.



20-gauge brass, soldering the joint. Spring apart the frame enough to slip the axle in.

Lay out the body blank and decorative strip on 20-gauge sheet brass. Hammer the bends to a good fit over a wooden block. Lay bits of solder inside and heat until it flows into the joints.

Centerpunch and drill the ¼" holes in the decorative strip, cut and file the scallops to shape, and flatten the strip. File notches at the front corners so that the hidden edge may be bent to match the slope of the front.

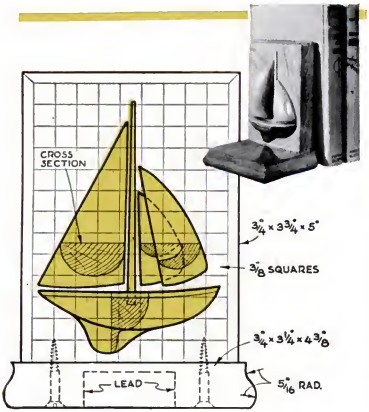
Bevel one end of the twisted strip, file notches almost through at the corner bends, and shape it to the body. Bevel the second end to fit the first, and solder it on.

Scour with kitchen cleanser. Then buff to a high luster. Tin the frame and body, and sweat-solder them together.

For the decorative domes, anneal a strip of 26-gauge sheet copper. Shape on a die as shown, or over a depression in a wooden block, using a ball-tipped punch. Anneal again before forming to full depth, or the metal will crack. Cut out the domes and file the edges flat.

File a bar of solder to obtain granules you can lay alongside these pieces after placing them on the body. Then apply a torch to flow the solder under them.

Wash the barrow in hot soap water, dry, and wipe with lacquer thinner. Apply clear lacquer to preserve the polish—*Bill Luther, Los Angeles.*



Seagoing Book Ends. Glance up at these from a sea story, and you'll almost hear the wind whistling in the rigging. What's more suitable for your adventure and hobby books?

Cut ¾" stock for bases and uprights, bevel or shape the edges, and hollow the bases. Mount fishing sinkers or sheet lead inside with countersunk screws. Cover the underside with felt or blotter material.

Use dark wood like mahogany or walnut for the hull, white stock such as maple or poplar for the sails. Jigsaw these parts to outline, and glue a thin piece of white wood to the hull as a deck. Shape roughly with a rasp, or on a sander. Then work with knife, files, and sandpaper. Taper a bit of dowel for a mast, flattening one side. Glue the carving on, stain and fill as required, and varnish.—*W. Freeman, Baldwin, N. Y.*

An Extra Chair You Can Build

Canvas webbing and hardwood framing make it strong and durable—and it's light enough to move around easily.

By Roland Cueva

You can dye the webbing any color you want. The leg arches are laminated for strength.

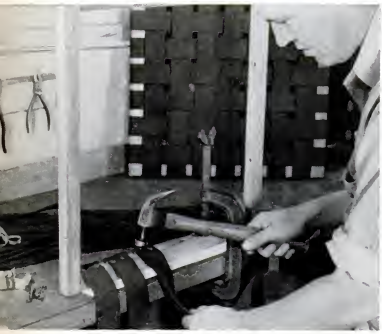
INDOORS or out, this webbed chair fills a definite need. During the winter, it's just the thing beside a TV set. When warm weather comes, you can take it out to the lawn or terrace, for weather won't harm it if you apply a protective finish. Materials to build it cost less than $12.

Poplar was chosen for the legs and arms because it is easily worked, strong, and has a natural whiteness that requires no bleaching for that up-to-date finish. The seat and back frames are hardwood.

Making the frames. The seat and back frames are identical squares. Corners are joined by mortises and tenons, glued up and clamped. Outer edges should be chamfered so the webbing will wrap smoothly.

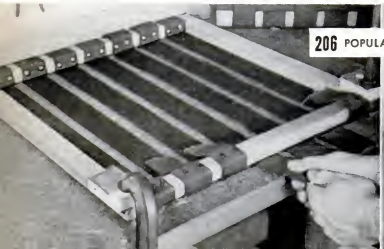
The structural frame holds the legs together and supports the seat frame. It is also square, but ¾″ larger than the seat frame to allow for the thickness of the webbing. It is put together with lap joints, glued, and reinforced with screws.

Legs are laminated. The accompanying drawing will guide you in laying out the legs. They are laminated in two layers. Each layer is ⅜″ thick (¾″ would be all right, too) and there are five pieces in each leg. The outer pieces join at the top and are cut with the grain running lengthwise. The inner layer has a top segment that crosses from side to side, with the grain running that

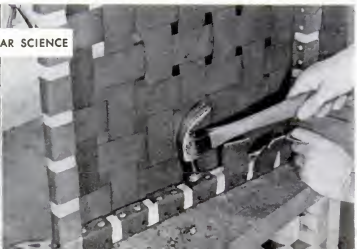


To apply webbing, clamp frame in vertical position, turn under ends of strips about ½″, and fasten with upholstery nails, two to each strip. After tacking all strips on one side . . .

Clamp frame flat. pull strips tight one at a time, and tack temporarily in wide part of frame. Then clamp frame vertically, drive upholstery nails on inside, and remove tacks.



Cross-webbing is done same way except that the strips are woven in and out of first ones. Be sure to space strips evenly. Here upholstery nails are being driven before removal of tacks.



way; and two lower segments with the grain running vertically.

Assemble them with a phenolic-resin glue and keep clamped tightly for 12 hours. After removing the clamps, sand all edges smooth. In cutting the two arms, notice that the notches into which the back frame fits are inclined backward at a 12° angle.

You can dye the webbing. For the webbing use 2″ heavy white canvas strap with selvaged edges. This canvas can be dyed any desired color with inexpensive dye available in dime stores. You'll need about 66 feet of webbing. Cut it into 28 strips 28″ long.

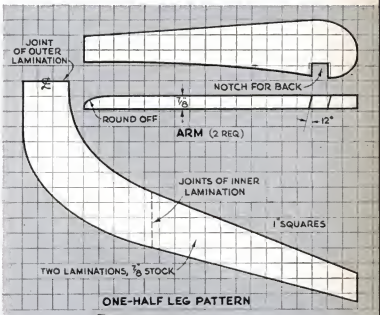
To facilitate the webbing work, make a cardboard rule the same length as the inside of the frame and mark it into seven divisions 2″ wide, starting at the end. This can be held next to the frame when the webbing is being attached, assuring accurate spacing.

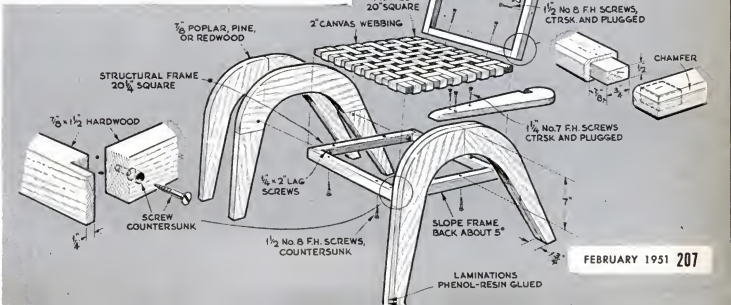
What finish? This is up to you, but remember to apply the final finish to the side and back frames before putting on the webbing. For outdoor use, a spar varnish or enamel does well. For indoors and a really modern job, clear lacquer and wax is the thing.

Final assembly. Do this after all units are complete. The seat frame is attached to the top of the structural frame with six 1½″ No. 8 wood screws driven from underneath and countersunk; two in front, two in back, and one on each side.

Next the arms go on, held by three screws into the tops of the legs. These screws are also countersunk and plugged with wood plugs matching the arm material. They are later sanded down and the top of each arm given another finish coat. The back is slid down into its arm notches until it rests on the back edge of the seat frame, where it is held by two or three screws driven into the latter. END

Structural frame is attached to the laminated legs with ¼″ by 2″ lag screws, placed inside.





This piece of furniture is easy to build but big and solid enough to be used in many ways.

Flooring Makes a Fine Table

By Robert Hoppough

Fluted edges of the top and the fluted legs look like shaper-cut parts, but they are really pieces of oak drawer slides.

THERE'S plenty of space on this man-sized table. You can lay out a four-handed card game without crowding and still have room for drinks and ash trays. It's 36¾″ square—about 400 sq. in. more top area than the average card table provides.

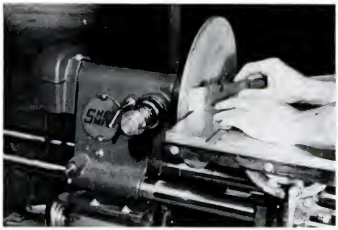
Legs are dressed two-by-twos with lengths of hardwood drawer slides nailed and glued to all four sides. Legs are doweled to table top.

The handsome top is built of scrap strips of hardwood flooring. The table is big enough and heavy enough to be used in a breakfast room, a dining area, or as a typing table.

Construction is simple. Start it with the top. Cut out a 36″ square of ¾″ plywood for the bottom layer. Miter the ends of the four strips of flooring that form the border of the top. Rip the tongue off the edges of these four pieces. Screw and glue three of these border pieces to the plywood square to form a U.

Fit strips of flooring into the U, nailing them to the plywood as shown in a photo on the opposite page. Screw and glue the fourth border piece in place. Miter the ends of some oak drawer slides and nail them around the top.

Use dressed two-by-twos for the legs, sawing them so the top of the table will be 29″ from the floor. Nail and glue oak drawer slides to the sides of the legs. This gives them a fluted appearance and matches the oak of the top and the slides around the edges of the top. Fasten the legs to the top



Disk sander is handy for truing mitered pieces. Top of legs also should be squared up before you dowel and glue them to the table top.

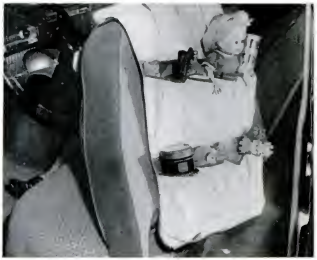
Drive nails at angle through tongue of flooring. That way the next strip of flooring will hide nailheads in preceding strip.

Counterbored holes for screws that hold border should be at regular intervals. Then plugs that hide screwheads will form a pattern.

with ½" dowels and glue. Add metal angles to strengthen the legs where they meet the top.

Sanding the top may be troublesome because two of the border pieces are at right angles to the other strips of flooring. Masking tape along these edges will aid in preventing cross-grain scratches. END

Shoe Bag Holds Toys on Auto Trips



If you take a long trip with children in the car, attach a shoe bag to the back of the front seat. It will easily hold a choice of toys to keep the children busy, and a few packages of cookies to tide them over when restaurants are far apart. Tuck in a comb and brush, some cleansing tissues, and a bottle of soapy water and you'll be all set for quick cleanups when necessary.

Tool Unscrews Ceiling Lamp Bulbs

Basement and apartment-house light fixtures are often set into the ceiling and beyond reach. The bulbs in such fixtures can be easily removed and replaced with a lampshade adapter, of the type shown, screwed to a long pole.—*Harry Waldron, Yonkers, N. Y.*

Would a Booster Help Your TV Set?

You have to try one to tell. But that can be done easily, and the results are sometimes really worth the effort.

By Robert Hertzberg

IF YOU are somewhat beyond the "normal" TV range and your pictures are weak . . .

If one station that you especially want comes in poorly . . .

If you are near a transmitter but can't have a roof-top antenna . . .

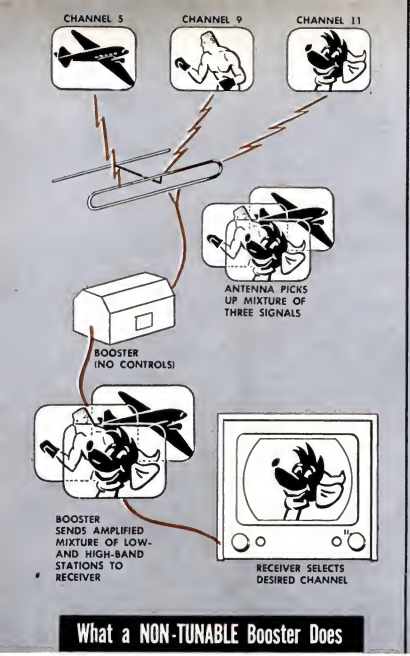
. . . You should try a television booster.

It may strengthen the faint signals plucked out of the air by your antenna. A booster can be attached to your set in a jiffy. The only tool you need is a screwdriver.

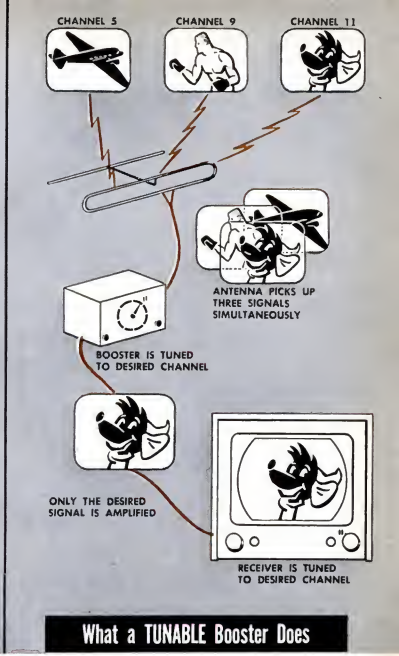
If the booster decidedly improves your pictures, you are in luck. If the images are still pale and snowy, you're not entirely out of luck; you can try boosters of other makes and possibly find a better one.

There is no way to be sure that a booster will help—except to try one with *your* receiver in *your* home. Recognizing this, many dealers will let you have one on trial. The best boosters cost only about $30, and a satisfactory one may prove much cheaper than a new set or an elaborate antenna.

Boosters may be roughly classified according to the number of controls that have to be operated. Tunable models require the most adjustment, semi-tunable boosters need somewhat less attention, and the non-tunable need no attention at all. Most non-tunable ones and some of the others have



What a NON-TUNABLE Booster Does



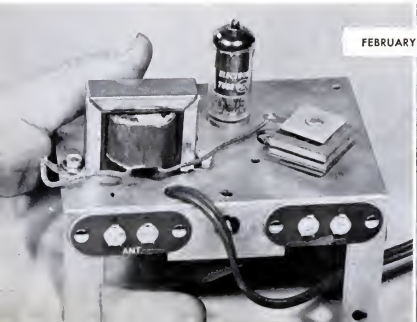
What a TUNABLE Booster Does

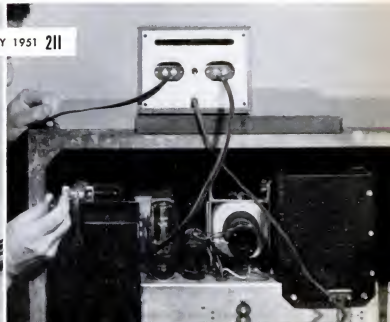
automatic switches that turn them on or off when the receiver is operated. In most of the automatic models the regular on-off switch is linked with an aerial change-over device that cuts the lead-in directly over to the receiver when the booster is turned off.

Generally speaking, the tunable boosters are the best. They not only give the most amplification, tube for tube, but under some circumstances they make the receiver slightly more selective. The semi-tunable type runs second, and the non-tunable third. Among all three types, there is considerable variation in the uniformity of amplification. Most

Simplest kind of booster uses only one miniature tube. Others have up to four tubes. Larger models usually contain two separate amplifiers, one for low and one for high band.

Booster is hooked up by removing antenna leads from set and connecting them to booster's "in" terminals. The "out" terminals are linked to receiver by short piece of lead-in wire.





Tunable boosters like this generally give most amplification but must be tuned to match set.

Semi-tunable type has switch for high or low band operation plus a fine-tuning adjustment.

Non-tunable booster requires no adjustment. Automatic switch makes it easiest type to use.

boosters are better on the low bands than on the high. The same is true, for that matter, of TV receivers.

A booster also may improve your neighbor's reception by eliminating interference that is generated in your set and radiated by your aerial. A booster, connected between an offending receiver and its antenna, acts as a buffer and prevents the energy from getting out to bother others.

A factor that limits the amount of useful amplification you can squeeze out of boosters is "noise" due to electronic agitation in tubes and to other obscure sources. This shows up on the screen as irregular splotches and may spoil the "boosted" picture.

One non-tunable booster is unusual in that it is designed for mounting on the roof, close to the aerial itself. It is being used even in strong-signal areas where the down lead from the antenna unavoidably passes close to electrical devices that cause interference.

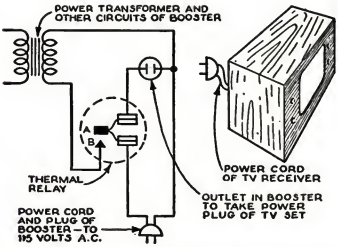
If a booster is placed near the receiver, it amplifies both the video signals and interference. But when placed between the top of the lead-in and the antenna, it amplifies the video signals but not the interference picked up by the lead-in.

The "best" booster is the one that gives results with your set.

If one booster amplifies signals to a certain degree, will two boosters in tandem work twice as well? A man in Pennsylvania is using this unorthodox combination with a classy antenna atop a 75-foot mast. He enjoys fairly regular reception on ten channels, including five stations that are more than 1,000 miles away! END

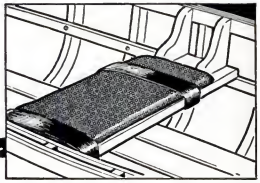
Color Need a Boost?

If you need a booster now, you'll need one at least as much to receive colorcasts. In the CBS method, the illusion of color is created by means of a revolving disk composed of red, blue, and green filters. These filters hold back part of the light, so the image on the picture tube has to be pretty bright before the filters are brought into play. A booster may make the difference between gloomy shades and bright color.



Typical automatic switch uses thermal relay. Contact arm, normally at A, allows current to reach receiver. When set is on, contact heats up, snaps over to B, and turns on the booster.

Inner-Tube Strips Keep Boat Cushions From Slipping



TACK a couple of pieces of rubber cut from an old inner tube across the seats of your boat. Slip the cushions under the strips of rubber and the cushions can't slide off the seats.—*E. Dzus, Prince Albert, Sask., Can.*

Tinning Paint Speeds Soldering

LOW-COST tinning of metal surfaces is a simple matter with this tinning paint. After old paint or other coats are removed from the metal, a coat of the tinning paint is brushed on. Heat is applied—usually with a torch—until the paint bubbles and turns brown. Then the surface is wiped with a cloth, leaving a tinned area to which solder will adhere. The paint, sold by Swiss Laboratory, Cleveland, Ohio, also can be used to tin welds. A 1-lb. can sells for $1.75.

Rolling Out the Screen Wire

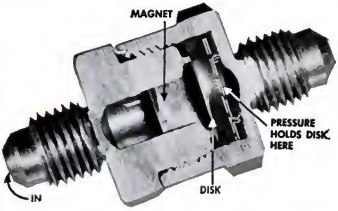
A PAIR of roller skates bolted to a counter bottom side up makes it easy to roll out screen wire for measurement at the C. J. Harris Lumber Company, Washington, Mo. You just lay the roll on the skates and pull.

Rubber on Hammer Saves Woodwork

WHEN you're working in close quarters, the hammer's claw sometimes mars nearby woodwork. You can prevent this by padding the claw with a piece of sponge rubber. Hold the rubber in place with a rubber band.—*Bess Ritter, Yonkers, N.Y.*

Magnet Replaces Spring in Valve

A TINY Alnico magnet built into this check valve is said to eliminate all pressure drop in the flow of fluid. A conventional spring-loaded valve exerts maximum back pressure when held wide open, but in this unit the magnetic attraction on the disk



falls away to almost nothing as the disk is forced away from the magnet. Magni-Chek is made especially for use in freon and sulphur-dioxide refrigerator systems by Wagner Tool and Supply Corp., Long Island City, N.Y. Only ⅞" in diameter and 2¼" long, it can be installed in any position.

Press photographer. Matty Zimmerman, AP cameraman, leans under the ropes to picture Janiro-Graziano fight, below.

How You Can the Fights

Like a ringside cameraman, you must anticipate the action. For best results, shoot at 1/50 sec.—and overdevelop.

By R. P. Stevenson

NEXT time you watch a prize fight on TV, keep one eye on the edge of the ring, and you'll occasionally see a newspaper photographer push his camera under the ropes to snap a picture.

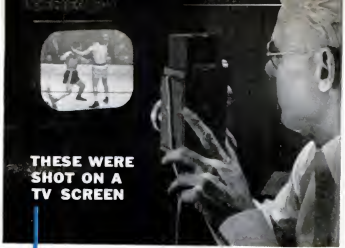
What these men do at ringside, you now can try at home—on TV. The pictures you get may not have all the zing of ringside shots but they'll be surprisingly good.

Shooting fights is a little more tricky than other types of TV photography. For one thing, you must try to beat the fighters to the punch with your shutter finger—just as news photographers do.

Listen to an expert's opinion: "You can't wait until you see a fighter land a blow," says Mathew Zimmerman, an Associated Press photographer who has shot many standout photos during his dozen years as a ringside specialist. "You've got to outfigure the fighter. You must shoot your pictures in that split second when the action is in the windup stage, so you'll record it when it happens."

You may have seen Matty during fights telecast from Madison Square Garden. At

Photograph Via Television



TV photographer. Bill Morris, of POPULAR SCIENCE, shows you how. His photos below are of same fight shown opposite.

ringside he always has the same position—the left corner opposite the TV camera.

"The experienced photographer knows his fighters, and their style of fighting," Zimmerman adds. "He knows pretty well when to expect the jabs, hooks, crosses, and uppercuts. He *has* to know if he is to get good action pictures."

At ringside, a press photographer shoots with overhead speed lights focused on the ring. When he trips the shutter, these throw a brilliant flash lasting only about 1/5,000 of a second. It is this flash, and not the shutter, that "freezes" the action of the fast-moving fighters.

TV requires slow speeds. As you sit before your TV set, with your camera rigidly supported on a tripod, you can't, of course, resort to such superspeeds. The nature of the television image itself limits your shutter speeds to the lower brackets. But to stop the action, you obviously want to shoot as fast as possible.

Ever since television came along, photographers have been advised not to shoot faster than 1/25 second. The reason? It takes 1/30 second for each image to develop fully. Hence, at any shutter speed faster than 1/30 second your photo would show an image that lacks some scanning lines.

But shooting at 1/25 second did not satisfy Bill Morris, chief photographer of

How images are produced on your television set.

Each 1/60 second the scanning beam, a pin point of light, moves in slanting zigzag lines from top to bottom of tube. This produces a "field." As it moves, the beam momentarily records an image made up of tones ranging from black to white. In a single field, your eye could see a recognizable image, but with spaces between lines picture would be incomplete.

A second scanning, also taking 1/60 second, is needed to give a full image. This is called the "interlace." Scanning beam moves back and forth over spaces not covered first time. Consequently, the interlace lets you see parts of image you didn't see in first field. Sketches are exaggerated. Actually, there are at least 250 scanning lines in one field.

Complete TV image consists of two fields, one interlaced with the other. This is called a "frame." A new one is produced each 1/30 second. A succession of frames, one following the other without measurable delay, creates action you see. In effect, each frame is a still picture. Actually, there may be slight movement of image from one field to next.

Popular Science. At that speed he found it next to impossible to get satisfactory TV photos of fights, dancing, and other fast action. So he set out to experiment with faster speeds—specifically 1/50 and 1/100 second.

And here are the results. Eventually he found that 1/50 second at f/3.5 gave him what he wanted—a good image with little or no movement. To compensate for the underexposure that results at these settings, even with Super XX and other film of equal speed, he overdevelops all his shots. Using D-76 developer, he gives his film 45 or 60 minutes of development instead of the customary 15. This formula causes no chemical fog in prolonged development, and in moderate enlargements his 2¼″ by 2¼″ negatives give no trouble from grain.

Turn brightness above normal. For all his TV shots Bill uses a 2¼″ by 2¼″ reflex fitted with a portrait attachment and moved in close to a 10″ screen. While shooting, he turns the brightness a little above normal—but not enough to wash detail out of the highlights. He shoots with the lens open wide at f/3.5.

If your camera has an f/4.5 lens, you still can probably get good fight photos by developing your film longer, say to 75 or 90 minutes. Should you be using sheet film, you can of course buy film that is far faster than the Super XX type. This will not require such long development.

Sketches show what happens. Why 1/50 second shutter speed is the most practical for stopping TV action is shown in the accompanying sketches. First, study how a TV image is formed. Then see what happens at different shutter speeds.

(This explanation refers only to between-the-lens shutters. Focal-plane shutters are sometimes used for TV shooting, but most photographers do not favor them because of their different action—a slit sweeping across the film.)

Even though some scanning lines are missing at 1/50 second, this makes very little difference. In moderate blow-ups, you'll never notice they aren't there. Best of all, the one scanning field and part of another enables you to get many shots without the blurs that come from fast action.

What about 1/30 second? In theory, a shutter opening of 1/30 second might be considered ideal, especially if the shutter could be synchronized to open and close with the beginning and completion of in-

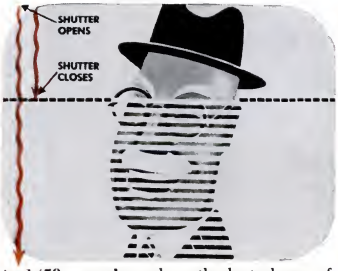
dividual TV frames. But modern between-the-lens shutters, except for one or two unreliable ones, don't offer 1/30 second.

Actually, if you had that choice you still would be better off shooting at 1/50. At the slower speed, your shutter opening could very easily straddle parts of three different TV fields—in each of which the subject may have moved slightly. At 1/50, you stay within two fields. END

What happens when you shoot at different speeds.

First point to remember is that it's a moving pin point of light, the scanning beam, that produces an image on film in your camera. Because of the rapidity with which the beam moves you may tend to think of a TV image as similar to your Uncle George—always there. But it's not. It just seems to be. Photographing a TV image is like opening the shutter of your camera in an absolutely dark room and then moving the beam of a spotlight back and forth across stock-still Uncle George, starting at his head. There's one difference, however. With Uncle G., you'd get a complete photo in one spotlight scanning from head to toe. On TV it takes two trips to fill in the picture.

At 1/100 second your camera shutter doesn't give the TV scanning beam time to form even a single 1/60 second field. Consequently, an unexposed strip shows up across negative. Where strip falls depends on what point scanning beam had reached when shutter opens. The same unexposed strip would result while you are spot scanning Uncle George if you closed shutter as the beam reached his knees. You'd get no photo of his feet because they were not yet illuminated. In a 1/100-second TV photo, unexposed strip may show some detail because the scanning beams continue to glow for about 1/1,000 second after beam has passed. If there's no strip, your shutter is probably slow.



At 1/50 second you have the best chance of taking action TV photos without blurring. At this speed you give scanning beam time to produce a complete field and a good part of another. The amount you get of the second will depend on how accurately your shutter is working. If it is actually slower than 1/50 second, as many shutters are, you'll get just that much more of the second field.

At 1/10 second you must catch your subject absolutely still to get a shot without movement. During that interval, the TV scene has been scanned six times. This means you have a combination picture of six different fields, in each of which subject may have moved slightly. You'll probably have blurred result above. At 1/25 second, or better still 1/50, you reduce chance of motion.

Home Incinerator Is Easily Assembled from Kit

In one package you get all the items you need to build this garbage-disposal unit, except for fire brick, flue pipe, and damper. Metal parts are heavy cast iron and the asbestos-board jacket is weatherproof, allowing the incinerator to be installed in your back yard or basement. According to the manufacturer, the Clear Mfg. Co., Butler, Wis., no professional masonry or mechanical skill is required to put the unit together.

Easy Way to Store Lamp Bulbs

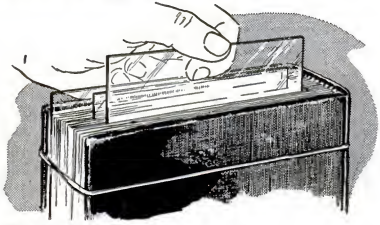
Metal or wooden curtain rings make convenient racks for extra lamp bulbs. Fasten the rings to a pantry or basement shelf with small wood screws inserted in the eyelets on the edges of the rings. Photoflood bulbs can be racked in the darkroom in the same manner—*John J. Rea, Urbana, Ill.*

Shoptalk

What are they talking about?
Where do they work? Answer below.

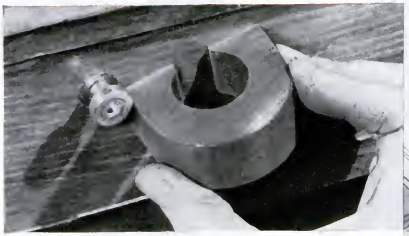
They're electricians in a movie studio. To scrim the baby means to place a cloth over the lens of a small light to soften and diminish the light output.

Sheet Glass Is Stored Safely Between Pages of Book



Small pieces of sheet glass, such as spare glass for photo and print frames, can be stored safely between the pages of a discarded book. Separate each piece of glass with a dozen or so pages. If the binding is worn and loose, a good many sheets can be accommodated without causing the volume to bulge. If it is too tight, remove enough pages to allow the volume to lie flat when closed on the pieces of glass and bound with some rubber bands.

Magnetic Lock Foils Snoopers

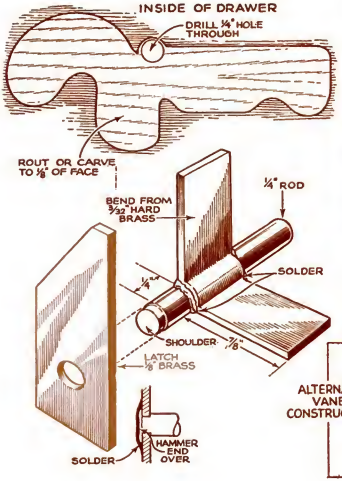


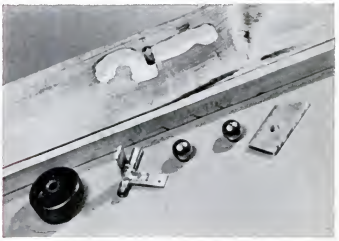
You have to know the "combination" to open a drawer or door bolted this way.

By Walter E. Burton

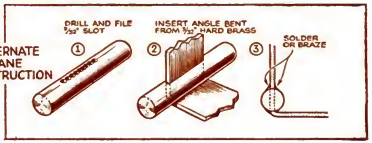
FIVE cents worth of hardware is enough to make a pickproof magnetic lock for any wooden door or drawer. It will baffle anyone unless he has a magnet *and knows just what to do with it.*

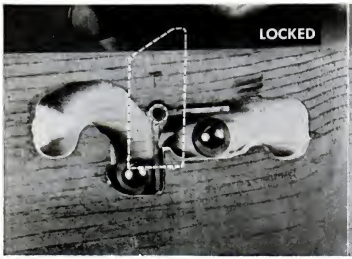
The latch is locked when two metal balls wedge metal vanes connected to its pivot, keeping the latch from rotating. To unlock it, you use a magnet to pull the balls away to the opposite ends of grooves routed in the inner face of the drawer front. All you need to make the lock are a few pieces of old brass and two small steel balls. Maybe you can salvage the balls from an old bearing. Any good magnet will serve as a key,

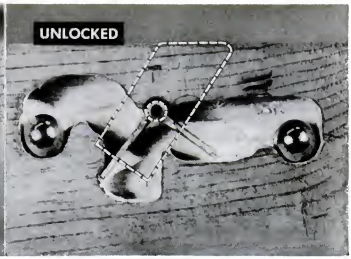




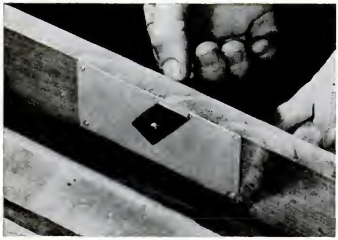
This magnetic lock is ready to be assembled. The grooves are routed to within ⅛" of the drawer front. Construction of the latch and two ways of making the vanes are shown in the drawing.







The drawer is locked when either steel ball is wedged between a vane and a side of the groove. Using two balls and grooves rather than one secures the lock against someone who knows you use a magnet but doesn't know just what path to follow.



A thin brass or aluminum cover plate holds the lock parts together and provides a bearing for the bolt. The latch should engage a striker plate in the frame. Fit a decorative knob to the outside end of the bolt so you can turn the latch.

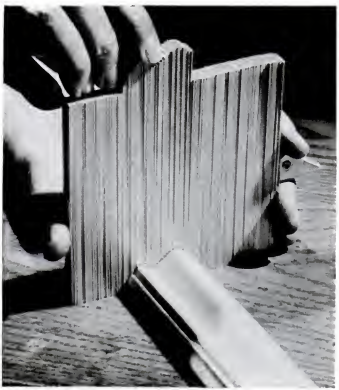
though an Alnico one is best. Don't use ferrous metal for the vanes, bolt, or cover plate.

If the front of the door or drawer you want to lock is less than ¾" thick, glue a block to the back. If there are grooves or mortises left by removal of an ordinary lock, glue in blocks of wood to fill them. Some cut-and-try fitting is usually necessary to get all parts to work smoothly. Inside tracks of the routed grooves should be reasonably smooth and there should be no places where a ball can become jammed. Oil each ball lightly to retard rusting.

Most magnets have well polished faces. If you find that sliding a magnet over the surface of the wood tends to scratch the finish, however, cover the magnet faces with cellulose tape. END

Metal Strips Copy Contours

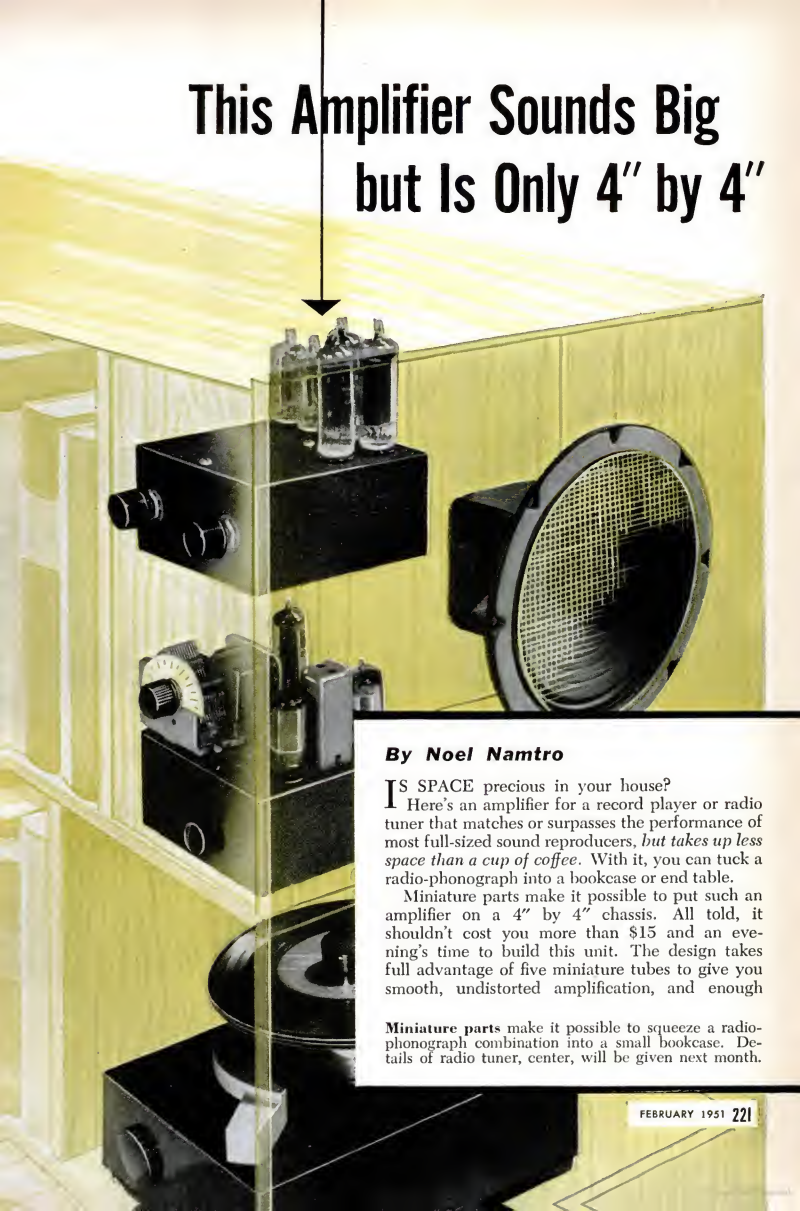
With a pack of aluminum stripes you can to copy the contour of almost any piece of work from moldings to rough stone. When the toggle clamp is in unlocked position (as in photo at right) strips can be moved up or down. When the strips are in position on the contour, the clamp is locked and the contour can be transferred to a drawing or to another piece of work. The tool is made in 12 sizes by The Ckola Company, of Minneapolis, Minn.



Nylon Used to Strain Paint

INSERT a circle of wire screening in a funnel, lay a piece of old nylon stocking over the screening, and you've got a setup to strain paint. Put the funnel over a jar or can and pour the paint over the nylon.—*Bess Ritter, Yonkers, N.Y.*

This Amplifier Sounds Big but Is Only 4″ by 4″



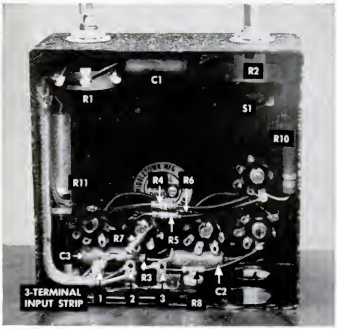
By Noel Namtro

IS SPACE precious in your house?

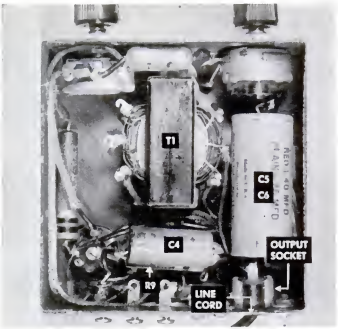
Here's an amplifier for a record player or radio tuner that matches or surpasses the performance of most full-sized sound reproducers, *but takes up less space than a cup of coffee.* With it, you can tuck a radio-phonograph into a bookcase or end table.

Miniature parts make it possible to put such an amplifier on a 4″ by 4″ chassis. All told, it shouldn't cost you more than $15 and an evening's time to build this unit. The design takes full advantage of five miniature tubes to give you smooth, undistorted amplification, and enough

Miniature parts make it possible to squeeze a radio-phonograph combination into a small bookcase. Details of radio tuner, center, will be given next month.



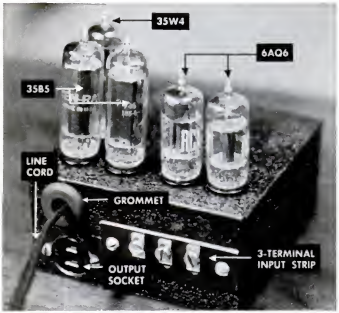
After you've drilled all chassis holes, mount the tube sockets, input strip, and controls. Wire the tube filaments in series, and connect the 6AQ6 cathodes (pins 2) together. Do the same with the 35B5 cathodes (pins 2) and screen grids (pins 6). Wire up the input terminals and volume control (R1) with shielded wire and ground the braid. Install the small resistors and condensers shown.



Bring the line cord through a hole in the back of the chassis, protecting it with a grommet at the point of entry. Wire one side of the cord to the switch, the other to pins 3 and 5 of the 35W4 rectifier. You can now install and wire the remaining large parts, such as the output transformer (T1) and socket, the dual-electrolytic filter condenser (C5, C6) and the remaining resistor and condenser.

sound volume to fill a room. Among its features are push-pull pentode output, a phase inverter, and separate volume and tone controls.

The secret of keeping this or any other electronic unit compact is to lay it out carefully and wire the parts systematically. Before you remove the miniature tubes from the cartons, stand the boxes on the chassis to determine the approximate spacing. Four of the tubes—two 6AQ6's and two 35B5's—fit in a straight line parallel to and about 1″ from the rear edge of the chassis. The fifth tube, a 35W4 rectifier, is directly forward of the last tube in this line.



Your completed high-fidelity amplifier looks like this. You can use it with almost any permanent-magnet loudspeaker if you select the right voice-coil taps on the universal output transformer. For the input you may use a record player, microphone, or an FM or AM radio tuner. Any two of these may be connected at the same time, for as you turn volume up on one you automatically turn it down on the other.

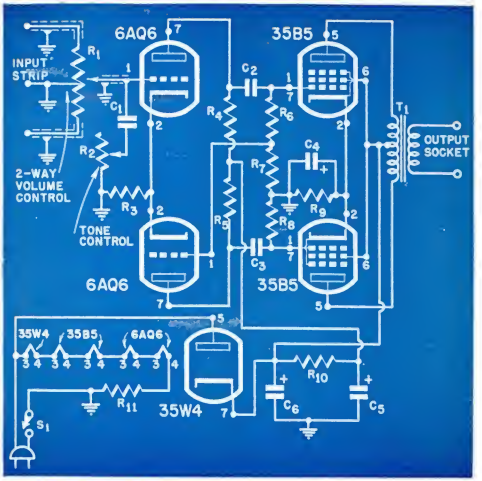
To seat the tube sockets, you have to drill, punch, or ream out holes ⅜″ in diameter. Some types of sockets can be locked in with clips; other types require additional holes for hold-down screws or rivets. On the back of the chassis make the necessary holes and cutouts for a 3-terminal binding post, a 2-prong output socket, and a rubber grommet to protect the line cord.

On the front, two ⅜″ holes—for the volume and tone controls—are needed. Mounting holes for the output transformer complete the drilling.

To conserve space and ease your work, proceed with the wiring in an orderly sequence. When you've finished, take a couple of minutes to recheck all the wiring. Trace the filament and line-cord connections. And look for blobs of solder that may cause shorts between the closely spaced contacts on the miniature-tube sockets.

LIST OF PARTS AND APPROXIMATE COST

R1: 1-meg. *center-tapped* potentiometer ($1.20).
R2: .5-meg. pot. with switch, S1 ($1.10).
R3: 560-ohm, ½-watt carbon (.10).
R4, R5: 100,000-ohm, ½-watt carbon (.10 ea.).
R6, R8: 220,000-ohm, ½-watt carbon (.10 ea.).
R7: 3,300-ohm, ½-watt carbon (.10).
R9: 68-ohm, 1-watt carbon (.15).
R10: 15,000-ohm, 1-watt carbon (.15).
R11: 10-ohm, 2-watt wire-wound (.20).
C1: .01-mfd., 400-volt paper (.15).
C2, C3: .05-mfd., 400-volt paper (.15 ea.).
C4: 25-mfd., 25-volt electrolytic (.50).
C5, C6: 20-40-mfd., 150-volt *dual* elect. ($1.).
T1: 8-watt, universal *push-pull* output trans. ($1.75).
S1: SPST switch on R2. (Incl. with R2).
Polarized output jack or socket (.10 to .50), 3-terminal input strip (.10), 7-pin miniature-tube sockets (5 req., .18 ea.), 2" by 4" by 4" chassis (.50), tubes, ($4.80), line-cord and plug (.20), misc. hardware.



If the assembly passes this inspection, insert the tubes in their sockets, plug the amplifier into a 115-volt AC or DC outlet and connect a loudspeaker to the output socket. If the amplifier doesn't work on DC, reverse the line plug in its socket.

You can link the amplifier to a phonograph pickup, a radio tuner, or both. If both are used, connect one to terminals 1 and 2 and the other to 1 and 3 of the input strip. The center-tapped volume control favors one pair of terminals when it's turned to the left and the other pair when it is moved to the right. END

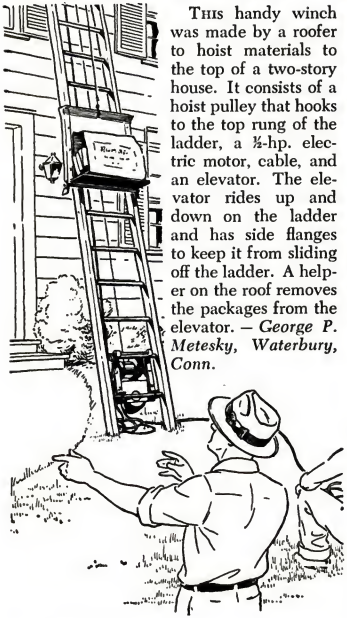
PAPERING PLYWOOD

Good papering can be done over plywood only when the sheets have been well-installed and separated from studs by furring strips to insulate them from frame movement. Joints should be tightly butted or filled with solidly glued splines. Fill all nail holes, hammer marks, and other blemishes with Swedish putty or a good commercial water putty, using a small trowel or wide putty knife. When dry, sand flush.

Coat the plywood with a wheat-flour paste fortified with a gelatin glue size. Put a coating of the paste on smooth building felt and apply it to the plywood, butting the joints and rolling smooth. For the very best results use a canvas or muslin sheeting instead of felt. Hang paper over either in the usual manner, using wheat-flour paste.

FOR YOUR POPULAR SCIENCE INFORMATION FILE

Homemade Winch Lifts Shingles



THIS handy winch was made by a roofer to hoist materials to the top of a two-story house. It consists of a hoist pulley that hooks to the top rung of the ladder, a ½-hp. electric motor, cable, and an elevator. The elevator rides up and down on the ladder and has side flanges to keep it from sliding off the ladder. A helper on the roof removes the packages from the elevator. — *George P. Metesky, Waterbury, Conn.*

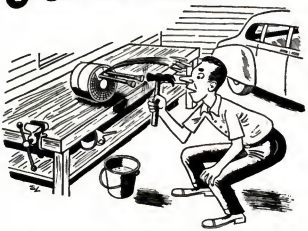
An Ash Tray for Pipe Smokers

A LARGE cork, about an inch and a half in diameter, cemented to the bottom of an ash tray makes a useful combination match-holder and knocker for removing pipe ashes. Cut the cork with a single-edge razor blade as shown.—*John J. Rea, Urbana, Ill.*

Squirted Flux Cleans Chemically

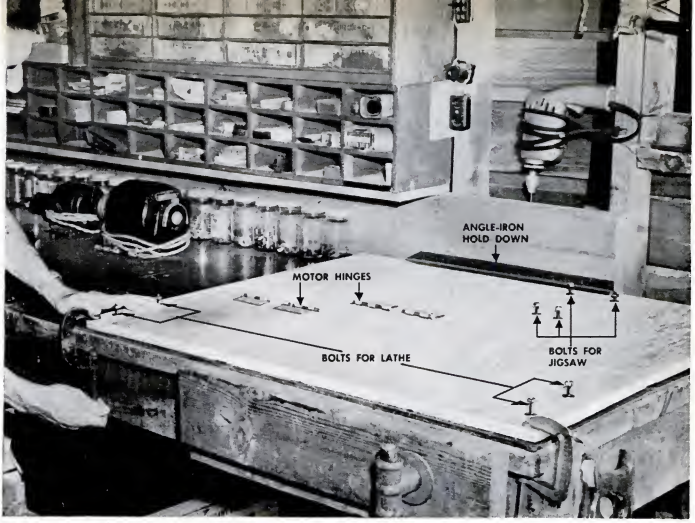
WITH a canned soldering fluid now on the market, you needn't scrape or sandpaper the parts to be joined, nor use a brush to apply flux. Squirted on the work right from the can, Divco Flux, made by Division Lead Company, Chicago, cleans by chemical action. It is said to work equally well on copper, brass, bronze, nickel, cadmium, zinc, tin, galvanized iron, and Monel. The four-ounce can sells for 50 cents.

My Most Ingenious Solution



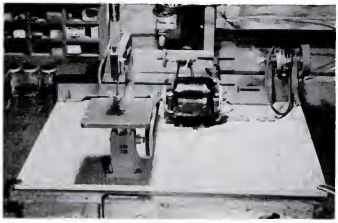
A leak in my car's hot-water heater only showed up when the engine was running. I took the heater out of the car and couldn't find the leak until I tried a simple experiment. What do you think I did?

I filled the heater with water and plugged both connections with corks. Then I tapped one cork with a hammer. Since water is incompressible, the leak showed up immediately. A simple solder job fixed it.—Roland Nagy, Clifton, N. J.

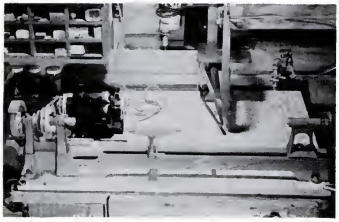


Rear edge of ¾″ plywood panel slips under angle iron. C clamps hold front corners secure.

Two-Faced Bench Saves Space



Jigsaw faces front. Note motor position. Bolt-heads are countersunk on underside of panel.



Lathe faces front. Panel has been turned 180° and motor moved. Outboard turning is possible.

MY SHOP is small. Space is always at a premium. Here was my problem:

I had to mount a jigsaw and a woodworking lathe.

One solution was to build separate stands for them. But stands would take up floor space. Another solution was to mount them on top of my workbench. That meant giving up valuable working space.

What I needed was a way to mount the tools so they would be rigid enough to use; make use of the same motor; and yet be easily movable so they could be stowed away when not needed.

The answer was a portable, two-faced bench top that I secure on my regular bench. With one face toward the front, the jigsaw is ready to use. Turn the top around and the lathe is in position.

Two pairs of loose-pin hinges bolted to the bench top locate the motor. One set of hinge leaves is bolted to the motor base. By pulling the pins I can turn the motor to drive either tool. Or I can remove the motor for other jobs.

When I don't need the jigsaw or lathe, I slip the bench top under my permanent bench.—*D. B. Neagley, Merced, Calif.*

How to Build a

Few sports give you the sheer thrill of speed that outboard racing does. Even a motor with low horsepower will send this hull skimming across the water.

By John Rogers

HOW can I get started in outboard racing? How much will it cost?

What kind of a hull do I need?

What kind of a motor do I need?

Put these questions to any 10 drivers of racing outboards and you'll probably get 10 different answers.

The Flying Saucer, shown below at rest, got its name from its disklike look when seen head on.

But here's one answer—one that you can do something about without laying out your life's savings for a racing outfit.

I built this racing hull—I call it the Flying Saucer—for about $45, including the steering wheel and aluminum fin. With a 7½-hp. Mercury motor, I can hit 30 m.p.h.

Building the hull is simple. I made every effort to avoid difficult construction operations. As you can see from the photos, the deck beams and frames were drilled to make them lighter. This is not necessary, but if you do drill them, don't get the hull's weight below the 75-lb. minimum required by the American Power Boat Association for Class M (midget) outboard hydroplanes.

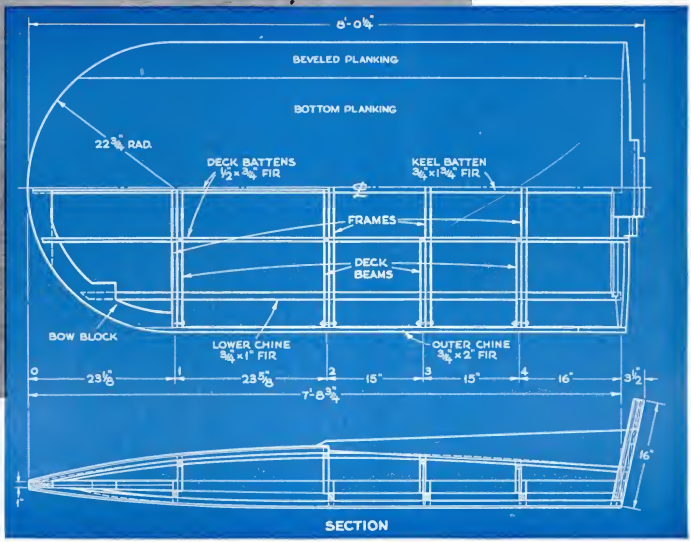
Accessories You'll Need

The photos and drawings on the next six pages give detailed, step-by-step construction plans. Besides the lumber, you'll need a steering wheel, a fin, and a throttle.

I bought an aluminum fin for about $2.

Flying Saucer

Full throttle sends the Flying Saucer skipping over the water. The boat looks like a professional racing hull but doesn't have a step bottom. Absence of step qualifies it for stock-boat racing. Profile and plan drawings below.



A 4″ by 8″ fin is the right size for this hull. The steering wheel cost $10 and the automatic, or crash-type, throttle cost about $6.

Screw the fin in the exact center of the keel batten. Locate it so the front of the fin is 36″ forward of the transom.

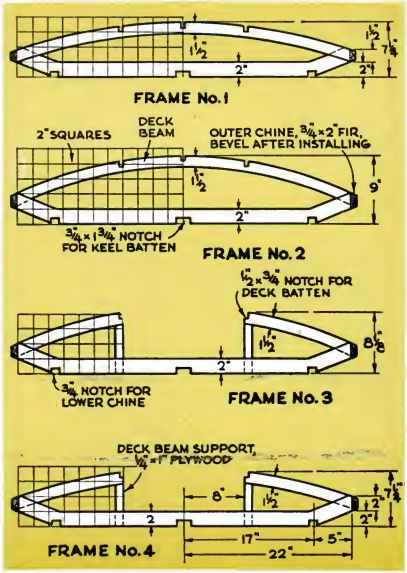
Painting the Hull

I gave the hull—except the deck—three coats of spar varnish. For the deck, I used white and flame-red auto enamel. This enamel has a high gloss and is not harmed by water, sun, oil, or gasoline. It may be waxed just like your car and sheds water like a duck. I used two coats each of red and white to give the deck a two-color job. Sand lightly between coats.

Lumber You'll Need

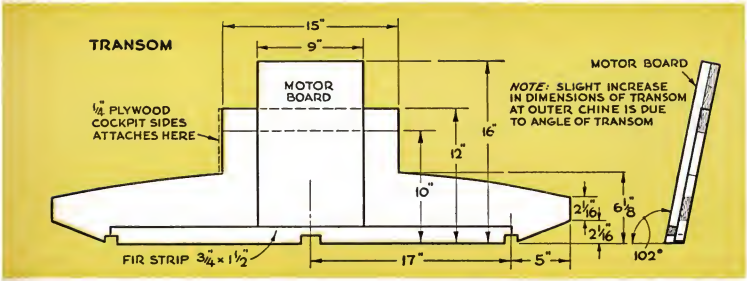
Frames: 1 piece, 1″x8″x8′ fir.
Deck Beams: 1 piece, 1″x8″x8′ fir.
Transom: 1 piece, 1″x10″x6′ fir.
Bow block: 1 piece, 1″x10″x8′ fir.
Keel batten, lower chine battens, deck battens: 1 piece, 1″x6″x8′ fir.
Outer chine battens: 1 piece, 1″x2″x8′ fir.
Bottom planking: 1 panel, ¼″x4′x8′ marine plywood.
Deck planking: 1 piece, ⅜″x4′x8′ marine plywood.
Brass screws: 2 gross 1″ No. 6; 2 gross ¾″ No. 5; 4 doz. 1¼″ No. 8.
Waterproof glue. Marine glue.

Turn the page for more pictures of this boat.

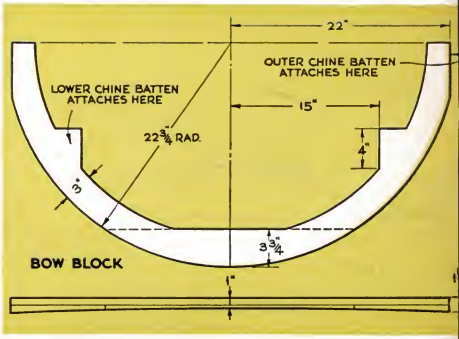


Frames and deck beams. The drawings with the squares give you the shape and dimensions of both frames and beams. Note that frame No. 1 measures 1½" at its ends. The other frames measure 2" at the ends. This is because the outer chine battens are tapered from frame No. 2 toward the bow. After you have the frames and beams cut out, trace the location of all notches for the battens on one frame and one beam. Then transfer the locations to the other frames and beams, as shown above. That way all notches will match. Frames and beams are bolted together in one of last steps of hull assembly.

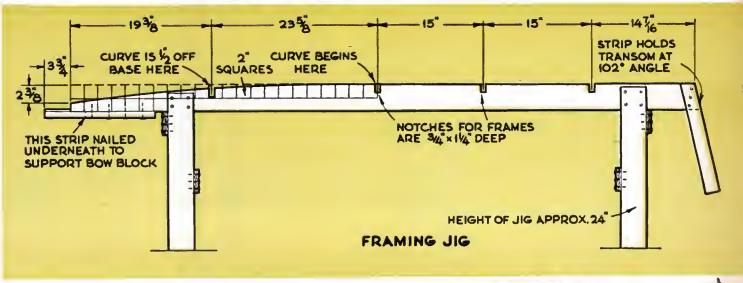
Transom. Lay out this stern piece from the drawing below. You have both plan and profile views. The profile shows you the 102° angle at which the battens meet the transom. Cut the angles carefully so the planking will be a smooth, tight fit. In the photo at right, the angle of the top of the transom is being checked. Notches for battens and chines have not been cut, but the ¾" by 1½" strip to strengthen base of transom has been added with glue and screws. Bottom of this piece must be beveled to match angle of transom's bottom. Attach the motor board with waterproof glue and ⅛" brass bolts, 2½" long. Then build up the back of upper part of motor board with ¾" fir as shown, attaching the pieces with glue and bolts.



Bow block. This part is laminated from two thicknesses of ¾" fir. Five pieces, as shown above, make up the block. The drawing at right gives you the shapes and dimensions of the parts. The two main pieces can be cut from the 10" by 6' fir plank. The other parts can be cut from leftover material. Use waterproof glue and clamp the pieces together to form the block. Let the glue set overnight. The profile drawing of the frame shows how the thickness of the bow block tapers from 1½" at frame No. 1 to 1" at the very front of the bow. Lay the block on a bench and taper it with a jack plane. Taper only one side. The side you taper will be the bottom of the bow block.



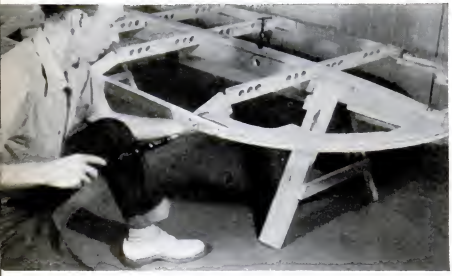
Framing jig. This is made from a two-by-four, 8' long. Select a straight two-by-four and lay out the notches as shown in the drawing below. The squares on the drawing show you the shape of the curve that begins at frame No. 2 and continues to the bow. Mark this curve on the two-by-four and saw it to shape. Then nail legs to the jig so it looks like the photo at left. Add the strips to support the bow block and the transom—as shown in the drawing below—and the jig is completed. Be sure the jig is level and solidly built.



Turn the page for more pictures of this boat.

Keel-batten assembly. After ripping the keel batten to size, cut one end of it to a 10° angle where it meets the bow block. Lay the bow block on the floor, bottom up, as shown above. Support the keel batten and attach it to the bow block with waterproof glue and two 1" No. 6 and two 1½" No. 8 screws. Then place the frames in their notches on the jig. Clamp the transom to the support that you have nailed to the stern end of the jig.

Bow-block and keel-batten assembly. Pick up the assembled bow block and keel batten and place the block on the framing jig. Clamp the bow block in position. Apply the marine glue to the center notch in each frame. Bend the keel batten down into the notches and clamp it. Then fasten the keel batten with two 1½" No. 8 screws into each frame. Attach the bow block to frame No. 1—as shown above—with waterproof glue and 1½" No. 8 screws.

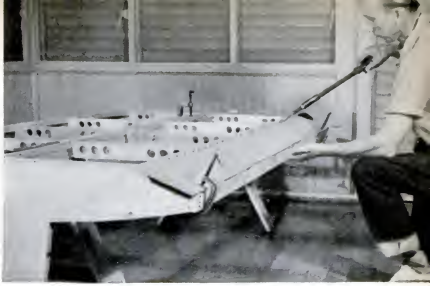


Outer chine-batten assembly. Mark the exact location of each frame on the outer-chine battens. Then when they are attached, the frames will be correctly placed. Excess material may be left on the stern end of the battens and sawed off after assembly. Taper the outer chine battens from 2" at frame No. 2 to 1½" at frame No. 1. Do the tapering on the bottom of these battens. The deck side remains perfectly straight. These battens extend 6" in front of frame No. 1, and are faired into the bow block. Attach the outer chine battens to the transom and to each frame, as shown in the photo at left, with marine glue and two 1½" No. 8 screws. Add two 1" No. 6 screws where the battens meet the bow block.

Lower chine-batten assembly. One end of these battens must be beveled 10° to fit the bow block. Apply marine glue there and clamp the beveled ends to the bow block. Then anchor the ends to the block with three 1" No. 6 screws, as shown in the photo at right. Use glue and 1½" No. 8 screws to fasten these battens to their notches in the frames and to the transom. Put one screw into each notch.

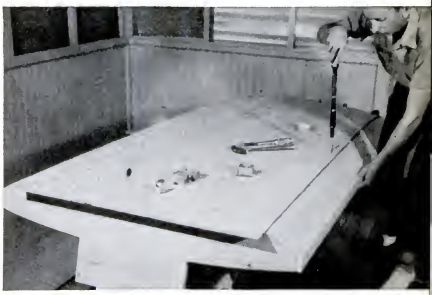
Finishing the frame assembly. The final step before applying the bottom planking is beveling and trimming the outer and lower chines but not the keel batten. Then the bottom planking will fit evenly. Go over the members with a plane—as shown below—to make sure the planking will fit snugly. Center photo shows you a bow view of the completed frame assembly, while the photo at right shows a stern view. Note holes in frames to lighten hull.

Beveled planking. The three parts of the bottom planking are cut from one 4′ by 8′ panel of ¼″ marine plywood. Be very careful in ripping this panel; it makes the bottom planking with very little waste. Rip two strips 6¾″ wide off the panel. These narrow pieces are attached to the frames, chines, and transom, as shown at right. Apply a liberal coat of marine glue to frames and chines. Then clamp the plywood in place. Attach to all frames, chines, and transom with 1″ No. 6 screws. Space the screws 2″ apart.

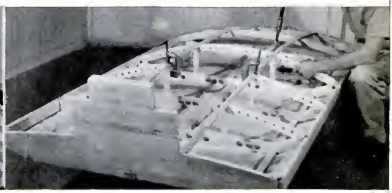


Trimming beveled planking. After all screws have been driven into the two narrow pieces of beveled planking, saw off the excess material at the ends of the strips flush with the back of the transom and around the curve of the bow. Hold a plane so its bottom is parallel with the side of the outer chine batten and trim off the edges of each strip until it is flush with the outside of the outer chine batten. Follow the same procedure where the plywood is attached to the lower chine batten, planing it flush as shown in the photo at left.

Bottom planking. This is what remains of your 4′ x 8′ panel of ¼″ marine plywood. Apply marine glue to the transom, battens, and frames. Place the bottom in position and clamp it to the bow block. Use 1″ No. 6 brass screws 2″ apart to attach the bottom. Drive screws along the keel batten first. Then drive screws along the lower chine battens, as shown in the photo at right. Saw off the excess material at the transom and bow. Do not bevel the outside edges of this piece of plywood. Leave it square. Finally, sand the entire bottom. Start with No. 1 paper and finish with 1/2 and 1/0 paper. Brush a coat of spar varnish over the bottom, outer chines, and transom. This first coat should be thinned with turpentine.



Deck beams and battens. With the bottom finished, turn the boat over. Bolt the deck beams to the frame with ⅜″ by 2¼″ brass carriage bolts. Use ¾″ No. 5 screws and glue to attach the vertical supports to beams No. 2, 3, and 4. You can see these supports in the photos below. Two deck battens run the length of the boat. The center batten runs from deck beam No. 2 to the bow. Fit all three in their notches with glue and attach them with 1″ No. 6 screws. The ends of the battens are beveled where they meet the bow block. Use a plane and sandpaper to see that battens fit flush with beams. Coat inside of hull and beams with spar varnish.



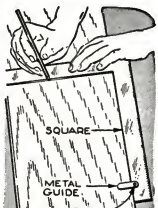
Turn the page for more pictures of this boat.

Deck planking. This is ¼" marine plywood and it is put on in four pieces. One piece goes on each side of cockpit (above) between transom and the center of deck beam No. 2. The other two pieces fit between beam No. 2 and the bow. The two forward pieces meet in the center of the center batten. Lay the plywood on the deck frame, reach under and mark the shape. Cut out with a sharp knife; sawing tends to splinter the thin veneer. Attach the plywood to beams and battens with marine glue and ¾" No. 5 screws. Place screws 2" apart. Leave about ½" of extra plywood around the outside edges when you cut out the deck pieces. Trim off excess after plywood has been screwed in place. On the forward planking, screw it to deck beam No. 1 first, then to center deck batten, to bow block, and to other deck batten.

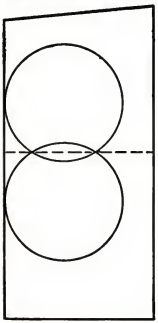
Cockpit. The sides of the cockpit are made of ¼" marine plywood. Apply glue to the edges of the transom and to the deck battens where those parts meet the cockpit sides. Attach the sides with 1" No. 6 screws, placed 2" apart, as shown in the photo below. To give yourself a comfortable place to crouch when you race the hull, nail floor boards of ¼" plywood over the frames on the bottom of the cockpit. You can make a duckboard for the cockpit bottom instead of the permanent floor boards. The bow end of the cockpit sides are notched to fit over frame No. 2. Paint the sides of the cockpit white to match rear of deck.

Support Keeps Framing Square Steady

When you square long boards with a framing square, the square has a tendency to rock. This can be prevented by supporting the body of the square on the board with a small metal guide mounted as shown. — *William B. Eagan, Louisville, Ky.*



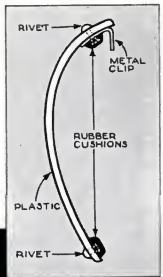
Two Circles Square End of Board



Here's an easy, accurate way to square the end of a board when a steel square is not available. Use a paint can—or any cylindrical object—and draw two circles that touch the edge of the board. Draw a line through the two points where the circles intersect. You'll have a line at right angles to the edge of the board. —*Hugh Lineback, Stillwater, Okla.*

Detachable Car Sign Tells Business

On workdays a sign like this will advertise your business. On holidays you can remove it. Two metal clips slip into the window ledge between the window insulation and metal, and small rubber bumpers protect the car finish. Autotach Sign Co., Rushville, Ind., makes the sign to fit practically all cars. The business name is applied to the plastic with an acrylic-base paint.



New Flash Reflector Folds Up

A NEW flash reflector introduced by E. Leitz, Inc., of New York, collapses like an old-fashioned fan when it's not in use. Folded, the reflector slips into your coat pocket. Made of leaves of dull-finish aluminum, the reflector is adjustable in height. It was designed for use with a new model Leica.

Here's a Handy Farm Cart

AN OIL drum cut as shown and mounted on a pair of bicycle wheels makes it easy to cart chicken feed, livestock supplies, and other items around the farm of Irvin McArthur, at Lovell, Wyo. The frame was welded together from pipe and strap iron.

Inner Tube Protects Level Bubble

I SAW a neat gimmick the other day. A carpenter had cut off a wide piece of inner tube and slipped it over his level to protect the glass when he carried the level in his toolbox.—*William B. Eagan, Louisville, Ky.*

Wear Her Photo on Your Wrist

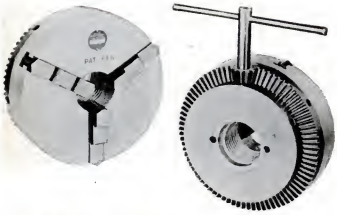
THE kind of metal watch band shown at the right can carry a photograph. Trim a small photo, cover it with a strip of clear acetate, and secure to the band with the two clamps. —*J. J. Rea, Urbana, Ill.*

Homemade Trailer Makes Handling a Sailboat Easier

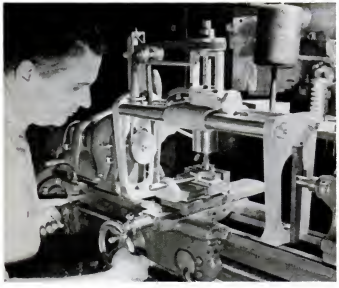
THIS welded steel trailer has two unusual features. The center frame member is curved up at the front (below) like a sled runner. After the trailer is rolled into the water and the boat floated free, the trailer can be pulled from the water by a length of rope. The upcurved member keeps the tongue of the trailer from digging into the ground.

The wheels, on two leaf springs, are well to the rear (left). This eliminates sway during towing.—*Tom Griberg, Moline, Ill.*

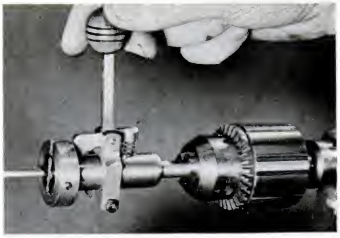
Lathe News



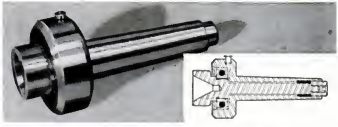
Two-Speed Chuck. You can lock work in place faster with this chuck. Insert the wrench in one of the six holes on the outside diameter of the scroll and rotate the scroll by lever action—by pulling on the wrench. That rapidly closes the jaws on the work. Then, to tighten the jaws, insert the wrench in one of the six other holes on a shoulder of the chuck and turn it. The maker is Westcott Chuck Co., Oneida, N. Y.



Vertical Milling Attachment. This miller clamps on the ways and is driven by the lathe spindle through a V belt. The lathe's longitudinal feed and cross feed advance the work, which is clamped in a vise on the cross-feed slide. The attachment, made by Montgomery & Co., Inc., New York City, will make a cut 8″ long and half the distance of the cross feed. The down feed, graduated in thousandths, has 3¾″ vertical travel. A T-slot table, 8″ long, is available as an accessory.

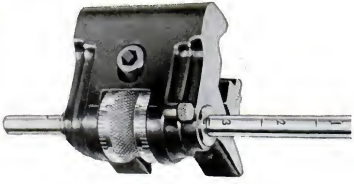


Threading Attachment. This tool is especially useful in threading work that has a shoulder. Pulling back on the lever lifts a latch out of the keyway, releasing the die so it is free to turn with the work. Then it won't jam against the shoulder and strip the threads. Mather and Robb, of Louisville, Ky., manufacture the Threadmaster in three sizes.



Live Center for Centerless Shafts. This tool comes in two sizes with top work capacities of ¾″ and 1″. The 60° cups of both sizes take work diameters down to 5/16″. A ball bearing carries both radial and thrust loads, and a rear pilot bearing eliminates center-shaft whip. The maker is the South Bend Lathe Works.

Carriage Spacer and Stop. Clamped to the ways, this accessory is a time saver on repeat work. Set it before starting operations and you don't have to stop to put a scale on the work. It's adjustable from zero to 6″ and it will hold a tolerance to .001″. Ellwood Products Co., of Detroit, is the maker.



Waterproof glue seals butt joints of plywood box. The top is hinged at back.

All kinds of seedlings can be grown to transplanting stage. Seeds are germinated in pans.

Sunless Garden Hastens Spring

By building this treasure chest for growing plants indoors, you can have a head start on your neighbors.

By Harold and Lillian Krelove

IN THE darkest, coldest room in our city home stands a box 16″ high and 25″ square, shaped somewhat like a pirate's treasure chest. Inside it, many seedlings and cuttings are receiving their nourishment from chemical nutrients and their life-giving light and heat from a 20-watt fluorescent "sun."

Out of this box have come many potted plants for window gardens and rooted cuttings of perennials for outdoor gardens.

How box was built. Our completely closed propagating unit was built after we had read reports of experimental work done by the Department of Agriculture. We used ⅜″ oak plywood throughout. Cedar or redwood is preferable, but more expensive. Butt joints were made with waterproof glue and fine nails. The shape of the top was designed to insure the greatest possible uniformity of light intensity on the growing surface. Two coats of spar varnish were applied to the inside of the unit, and the top was given, in addition, a coat of white gloss enamel and a finish coat of spar.

White lamp gives best results. The fluorescent unit consists of a 20-watt channel with a 3,500° white lamp. Pink lamps produce very soft growth. With a daylight lamp, growth is slower—but sturdier. The lamp is installed 5″ or 6″ above the growing surface, with sufficient air space between the channel and the unit lid to prevent overheating of the transformer. Because the highest intensity of light is at the center of the tube, plants in that area grow most rapidly. But they can easily be moved around so that growth is uniform. To root cuttings, light of 500 foot-candles intensity is needed; to grow seedlings, about 750.

What to use for growing medium. The growing medium can be regular garden soil, sand, or gravel, but we found vermiculite to be ideal. Vermiculite is mica that has been subjected to high temperatures and pressures, forming exploded particles that are extremely porous and light. It contains no toxic material, no vegetable matter, and consequently is a sterile medium. This

SEASON	CUTTINGS	SEEDS
Feb., March, April	Softwood shrubs	Vegetables, flowers
May, June, July	Spring-blooming perennials and shrubs (after flowering)	Late vegetables
Aug., Sept., Oct.	House plants	House plants
Nov. and Dec.	Summer-blooming shrubs	Any shrubs you'd like to try

eliminates all worries as to weeds and disease. Because of the small particle size and light weight of the material, removal or transplanting of small plants is very easy and safe. One trade name for horticultural vermiculite is Terra-Lite. You can also use the kind that is sold for wall insulation.

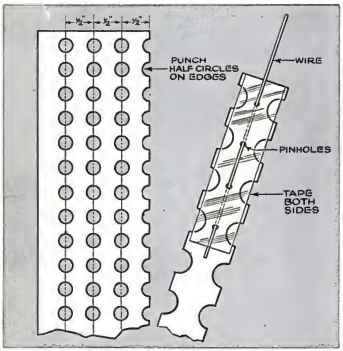
Since this medium contains no plant food in itself, it is necessary to supply nutrients. Application of any good, commercial plant food every other week is sufficient. We have used a solution made by dissolving Plantabbs in tap water. The vermiculite is thoroughly soaked before plantings are made. The application of the food solution, plus occasional light sprayings of the foliage, will then supply all the moisture needed at the roots and to keep the atmosphere humid. Opening of the unit for these operations provides sufficient ventilation.

You can pack in the plants. Because of the nature of vermiculite, plants may be grown much closer than would be possible in soil. For 2″ or 3″ seedlings or cuttings, 1½″ to 2½″ spacing is sufficient. You can germinate seed either in the unit (preferably in seed pans so each kind can be kept separate and easy to find) or outside.

The vermiculite can be piled in the bottom of the unit, or it can be put into regular growing flats. Addition of drainage material is not necessary because of the high absorptive capacity of vermiculite. For best results, operate the fluorescent lamp 24 hours a day.

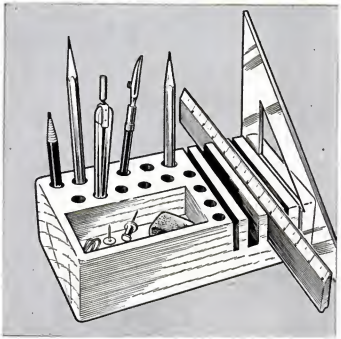
As the above chart shows, you can use the box throughout the year. END

Leader for Wire Recorders



SPOILED roll film can be turned to good use as leaders for recording wire. For standard wire-recorder spools, mark the film in strips exactly ½″ wide. Use a metal-edged ruler and a pin to scribe the lines. With a paper punch, make a series of holes along each line, then scissor out the strips. Punch four holes in a row in the center near one end of the leader, feed the wire through, and fasten it with cellulose tape.—*Karl L. Martin, Cleveland.*

Tray for the Draftsman



THIS combination tray and rack for drawing instruments holds everything within a 10″ by 5″ by 2″ space. A wooden block of these dimensions is drilled to hold pencils, pens, knife, and compass, and grooved at one end to receive half-circles, triangles, and the slide rule. A deep tray is hollowed out to store erasers, pen nibs, and other small items. All equipment is kept neatly arranged, ready for use, easy to carry.—*Wolfgang Wagner, U. S. Zone, Germany.*

Individual Salt and Pepper Shakers Are Easily Made

TINY salt and pepper shakers for school or work lunch boxes are quickly made from the plastic caps on ready-whipped cream containers. Drill a pattern of 1/16″ diameter holes for salt and 3/64″ diameter holes for pepper. Fill the shakers from the bottom and plug with a piece of cork ⅜″ thick. Each shaker holds about a teaspoonful. Leave a bit of the cork projecting for easy removal.—*Jack Wilson, San Pedro, Calif.*

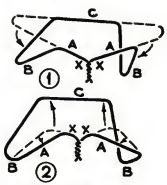
This Scrap Pad Won't Get Lost

A ROLL of adding-machine paper fixed to a cabinet with a long screw and a washer provides scrap paper in kitchen or workshop. Or drill a hole in the cabinet to hold a long dowel, slip the roll over the dowel and cap with a washer and screw. Then you need remove only the end screw to replace the roll of paper.—*H. Leeper, Canton, Ohio.*

Bookrest Bent from Wire Hanger

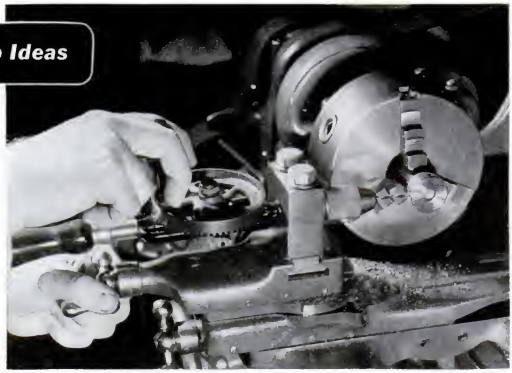
YOU can make a bookrest out of a wire coat hanger by bending it with your hands. Break off the hook and file the jagged tip smooth. Place the hanger on the edge of a table with about a third of its length projecting. Bend the projecting end down at a 90° angle. Bend a 90° angle at the opposite end, making the form shown in Fig. 1.

With thumbs at points X, bend down sides A with both hands until sides B lie almost flat on the table, as in Fig. 2. With a book on the stand, adjust side C until the book lies at a 45° angle, Fig. 3. The tip steadies the stand, which can be adjusted to hold almost any size of book.—*D. L. Johnson, Columbia, Mo.*



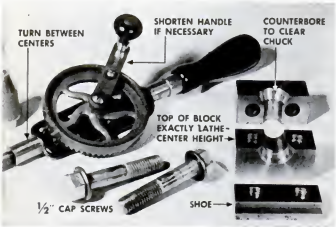
They're steel workers. An alligator is a type of shears for cutting up scrap iron. In this case steel rails were sent to the alligator to be cut down to four or five foot lengths for use in open hearth furnaces.

New Shop Ideas



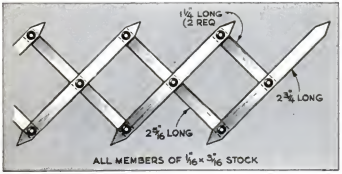
Drilling Radial Holes. Your lathe can be used to index holes on a circumference and drill them on a true radius. Just mount a hand or breast drill on the compound rest as shown. With a different mounting you could also use an electric drill.

Disassemble the drill and mount its frame between centers on the hole through which the spindle fits. Then turn the outside of the spindle housing true. The drill holder consists of two blocks of cold-rolled steel, the lower one exactly as tall as the distance between the top of the compound and lathe center height.



Clamp the blocks on the compound with a shoe in the T slot. Lock the compound parallel to the ways. With a drill in the lathe chuck, make a hole a clamp-tight fit for the turned drill frame. If the drill chuck hits the holder before the jaws fully close, counterbore the blocks with a boring bar or fly cutter. Should the drill handle hit the holder, remove it and mount a knob directly on the gear.—*Joseph Tracy, Manhattan, N.Y.*

Stretching Out Spaces. To mark off equal spaces automatically on layouts or work, you need only stretch the required number of points on this tool over the length to be divided. The tool can be made with as many legs as you wish. Cut these from steel or aluminum strip and join with tubular rivets. Drill the rivet holes to a close pivoting fit, and be sure to align accurately all holes and points on each leg.—*R. J. De Cristoforo, The Bronx, N.Y.*

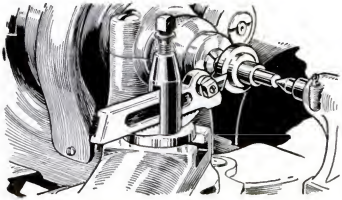


Telling Drills Apart. It's sometimes important to know whether a drill is carbon or high-speed steel, but they do get mixed and chuck wear often renders shank markings illegible. My solution for this is to grind the ends of all carbon drills flat, leaving those of high-speed drills pointed. This doesn't affect them in any way, and I can tell immediately by sight or feel which is which.—*Jack W. Bessman, Augusta, Ga.*

Restoring Threads. Running a nut onto a bolt before you saw it short can save time and temper. As the nut is unscrewed, it reshapes marred threads. If you want to file the end, do that too before removing the nut.

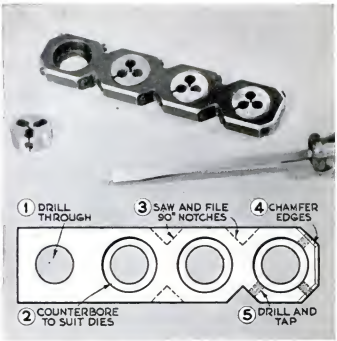
Powered Auger Bit. Common auger bits are dangerous to use on a drill press, for the pilot screw drags them in too fast. But if the threads are filed off, the bit is no longer much use in a brace. To convert it temporarily, turn a piece of copper tubing tight on the pilot. Make holes the size of the tubing with an ordinary drill where the bored holes are to be centered. The copper tubing is easily removed without harm to the pilot threads.—*John J. McGuckin, Ridgewood, N. J.*

Spotting Hidden Holes. Sheet metal, composition board, and other thin materials have to be clamped between pieces of wood if clean holes are to be drilled in them. But this makes it hard to spot holes precisely. The answer is to centerpunch the work where the hole is wanted, clamp wood to the back, and drill through both parts with an undersize drill. The drill or a piece of wire the same diameter is then pushed through to align these two pieces while another piece of wood is clamped to the front. Then drill to size through the pilot hole from the back.—*Paul Woodruff, Chicago.*



Reducing Mandrel Chatter. Sometimes good-sized work has only a small center hole, and so must be mounted on a small mandrel for which it is proportionately oversized. When the setup is turned between centers, considerable chatter may result.

The cure is to hold one end of the mandrel, as close to the work as possible, in a collet, and support the outer end with the tailstock center. The slight mandrel taper does no harm to the collet. Surprisingly big work can be turned on the smallest mandrels this way.—*John C. Martin, King's Point, N. Y.*



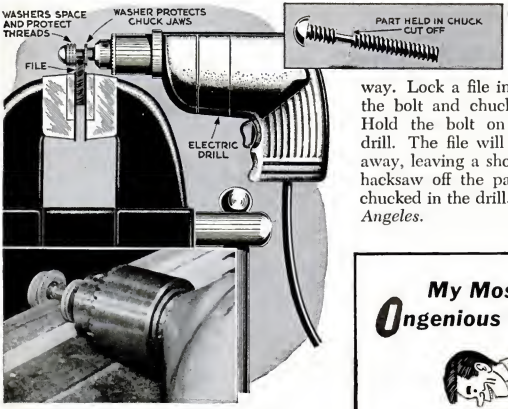
Four-Way Die Stock. Just pick this up and you have your most commonly needed dies ready to use. It's a good addition to a serviceman's tool kit, too, for this unit takes the place of five easily misplaced or forgotten pieces.

In a piece of steel of a thickness and width to suit the dies, drill the through holes to any convenient size. If you have a counterbore of the die diameter, drill holes to suit the pilot of the counterbore, which can then be used to form die seats.

Lacking a counterbore, you can clamp the stock to a faceplate, using a thin button to center each hole in turn, and bore the seats. Saw and file the notches, chamfer all edges, and tap holes for the setscrews.—*Floyd McGuckin, Ridgewood, N. J.*

Deburrer and Countersink. Until you have one, you can't guess how handy this tool can be. It deserves a place on any bench and in any repairman's tool kit. Grind a flat like that of a screwdriver on the shank end of an ordinary countersink. In an old plastic screwdriver handle, drill an undersized hole not quite to shank depth. Heat the handle by immersing it for a few minutes in boiling water, and drive the shank in.

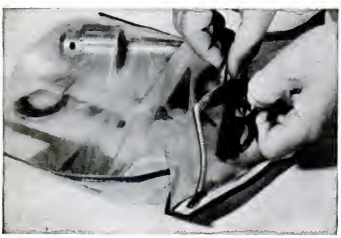
File and Electric Drill Are Used to Cut Shoulder on Bolt



If a lathe is not available, you can make a bolt with a shouldered end in this way. Lock a file in a vise. Put washers on the bolt and chuck it in an electric drill. Hold the bolt on the file and start the drill. The file will quickly cut the threads away, leaving a shoulder on the bolt. Then hacksaw off the part of the bolt that was chucked in the drill.—*Charles H. Hardy, Los Angeles.*

Simple Wall Rack Holds Scissors

A holder to keep four pairs of scissors handy but still out of reach of small children can be made from two empty cellulose-tape dispensers. Open the sides and, with pliers, bend out the serrated cutting edges. Flatten each piece with a hammer. Drill a bolt hole in one piece close to the cutting edge. Place the two pieces of metal together, as shown, over a small angle bracket and bolt through the drilled piece, gripping the other between the bracket and a ¾" washer. Attach the bracket to the wall.



My Most Ingenious Solution

In my work as a millwright I often have to cut holes through concrete floors and walls. In so doing, I usually run into a steel reinforcing rod. Most of the openings I make are too small to admit a hacksaw and the rods used to give me a lot of trouble. But not any more. How do you think I get by them now?

I use an electric hand drill. I first use a small drill to put a hole through the rod where I want to break it. Then I ream it out with larger and larger drills until only a thin shell remains. A sharp tap with a hammer and cold chisel finishes the job.—Carl Barkham, North East, Pa.

Bags Protect Tools from Rusting

Transparent refrigerator bags make fine moistureproof containers for seldom-used tools. They're fine for precision tools for which you don't have fitted cases. Oil the tools well before storing them in the bags.—*B. Ritter, Yonkers, N.Y.*

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Kodak Enlarging Lenses for the Flurolite range from the Kodak Enlarging Ektanon Lens, 2-inch *f*/4.5 (for negatives up to $1\frac{5}{16}$ x $1\frac{5}{16}$ in.)—$22.50 . . . to Kodak Enlarging Ektar Lens, 4-inch *f*/4.5 (for negatives up to 2¼ x 3¼ in.)—$56.00.

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Care and Feeding of Engines

BY S. P. CORP

HOW OFTEN TO CHANGE OIL?

Within the past year there have been many conflicting recommendations on how often to change oil. One magazine article suggested that every 4000 miles is often enough under normal conditions. The point most often missed is that the average car owner does most of his driving between home and work. The engine does not have time to warm up enough. Sludge forms.

This sludge is potentially dangerous to your engine, no matter how efficient your oil filter. The best insurance against such danger is to change oil every 1000 miles.

WHAT ABOUT TIRE PRESSURE?

Many drivers are confused by conflicting advice on the new low-pressure tires. If you were told to keep this pressure at 24 pounds, remember that that means 24 pounds in a cold tire. A tire with a cold pressure of 24 pounds may have 29 pounds when hot. If you have tires checked while hot, and have the 29 pounds pressure reduced to 24, you will be running on under-inflated tires, and will notice rapid tire wear or uneven wear. If you have your low-pressure tires inflated while hot, inflate them to 29 pounds. They will have only 24 pounds when they cool off.

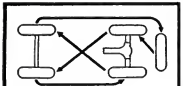

FIG. 2

SWITCH TIRES FREQUENTLY

Due to different kind of wear on front and rear, it is important to switch low-pressure tires frequently, following the method indicated in Fig. 2.

WATCH FOR EXHAUST SMOKE

If you buy a used car, or if your new car has gone more than 20,000 miles, watch for exhaust smoke—an indication that you need new Sealed Power Piston Rings. There is a set of Sealed Power Rings specifically engineered to do the best possible job in your engine, whatever the make, model, or engine condition. No other ring equals the Sealed Power MD-50 Steel Oil Ring for oil control, even in badly tapered and out-of-round cylinders. To save oil, save gas, and restore engine power, get new Sealed Power Piston Rings when your exhaust smokes!

Gus Parlays a Pair of Hunches

[Continued from page 192]

over, settled his bulky frame on it, and maneuvered it and himself under the front end of the car. But he had no more than disappeared than he reappeared.

"Stan," he said as he got up off the creeper. "Hold the fort for a while, will you? I want to see Jerry over at the police barracks. I'll finish up this job when I get back." With that he grabbed up his coat and hat and disappeared through the shop doors.

Ten minutes later, the veteran garage man was escorted into the police squad room where Sergeant Jerry Corcoran had his desk.

"It's just a hunch, Jerry," Gus began, "but have you thought of the possibility that those snow tires could have been put on the murder car backwards—you know, deliberately, with the Vs pointing to the rear instead of toward the front so the tracks would look like they were going when they actually were coming?"

The Hunches Don't Hit Home

Jerry smiled. "Sorry, Gus, but the lab boys gave that one a whirl too, but when we picked up the men and the car the tires were on with the Vs pointing forward at the top. And nobody goes around switching wheels in the dark on snow-covered roads. That job is pretty tough without a big jack like you've got at the garage. They wouldn't have had the time."

"Maybe you're right," Gus agreed grudgingly. "Just a thought. Now I've got one more screwy idea and then I'll stop playing detective and get back to work."

"What is it?" asked Jerry.

"Know that old road-commission shack just off the main road down near Trayton's place?"

"Sure," answered Jerry with a nod.

"Well just to satisfy my curiosity, Jerry, I wish you'd have a look at it. In good weather, the road-repair boys generally store some of their equipment there and always have a jack and a few tools handy for repairs. I've been thinking it might be a good spot for someone to switch wheels on a snowy night."

"Could be. Your guess is as good as anyone's right now," Jerry admitted. "But I think you're barking up the wrong clue."

Late the same evening, just as Gus was

[Continued on page 246]

This is the motor that lifts your sights to new horizons of boating fun and outboard usefulness

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only 85 POUNDS

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*O.B.C. Certified brake H.P. at 4000 R.P.M.

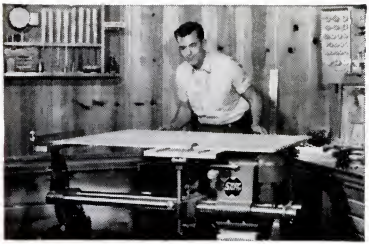
F. O. B. Factory, Milwaukee, subject to change without notice.

TAKE another look at the photo above. See those paper-thin strips? All four were sliced from the same piece of wood in sixty seconds *without changing the rip fence setting.* How? It's easy with SHOPSMITH. You can shift the *saw blade* as well as the fence—using SHOPSMITH'S exclusive micro-feed blade adjustment.

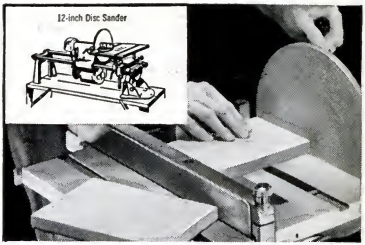
There's not much you can do with wood strips. What's important is the speed and extreme accuracy of SHOPSMITH'S fence-to-blade settings. And this is just one of SHOPSMITH'S many precision features.

The disc sander, for example, feeds into the work, can be set to stop on a hairline. The vertical and horizontal drill presses have built-in jigs, unique micro-settings. The centerless ground steel ways are stress-tested at over a ton, assure absolute rigidity and accuracy in lathe work as well as in other operations.

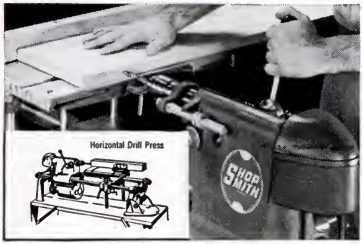
Add 'em all up—accuracy, capacity, flexibility, rugged construction and precision features—and you'll begin to see why SHOPSMITH is America's most popular power tool. See SHOPSMITH demonstrated at leading hardware and department stores or any Montgomery Ward store. And for complete details and specifications, mail the coupon.



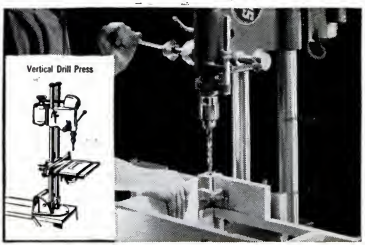
BLADE TO FENCE—48". You won't find many saws under $200 that offer capacity like this. It means you can cut to the center of 8' plywood panels, handle extra-long boards, trim doors, screens, storm sash. Table tilts, raises, lowers. Maximum depth of cut 2¼".



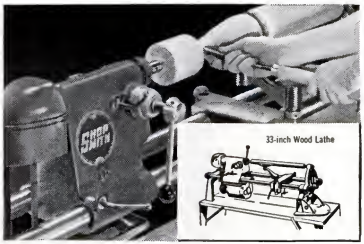
90° ON THE NOSE. SHOPSMITH as a disc sander is so accurate you can forget about your try square. Can be used as a jointer too. Work fed through at a slight angle (by cocking fence) comes out with a beautifully jointed edge. Sandpaper discs easily replaced.



PERFECT DOWELED JOINTS. No jigs required. Just lay the work flat on the table, feed drill from side. Dowel holes match perfectly. Horizontal drill is especially useful when drilling large, awkward work. Its capacity is limited only by the length of your workshop.



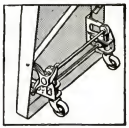
FLOOR MODEL, TABLE MODEL. SHOPSMITH as a drill press is both. Maximum clearance, table to chuck, 27", floor to chuck, 55". Jacobs key chuck takes drills up to ½" diameter. Speeds range from 875 to 3500 rpm. 4" quill feed. Easy to read, adjustable depth scale.



ROOM TO TURN IN. SHOPSMITH as a lathe has a 15" swing—4" more than most other heavy-duty lathes. It has a quick-set tool rest that always moves parallel to your work-piece. And it's the only lathe that lets you face the work while face-plate turning.

NEW RETRACTABLE CASTERS

. . . increase SHOPSMITH'S already great flexibility. They're easily mounted on any wood or metal bench. Easy to set, too, with three-stage foot levers that raise or lower unit. Your SHOPSMITH dealer has them. Complete set . . . $11.95.



ADDRESS:

SHOPSMITH, Dept. 152-A, *at factory nearest you:*

12819 Coit Road, Cleveland 8, Ohio, OR
417 Montgomery Street, San Francisco 4, Calif.

Please send me the free SHOPSMITH booklet.

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*Address*_____

*City*_____ *State*_____

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A GOOD
ELECTRIC DRILL
BY ITS CHUCK

JACOBS

If it's a JACOBS
It bears the name...look for it!

Jacobs Plain Bearing Key Chuck...the most widely used drill chuck in the world. You can trust the tool that has one.

Jacobs Rubber-Flex Hex-Key Chucks on home workshop power tools prove that their makers put quality first.

Jacobs Rubber-Flex Hand-Tite Chuck. One-piece RUBBER-FLEX jaw assembly holds tools true and tight. No loose jaws or springs.

IF IT'S A

JACOBS

IT HOLDS

The Jacobs Manufacturing Company
West Hartford 10, Connecticut

Gus Parlays a Pair of Hunches

[*Continued from page 242*]

about to close up shop and call it a day, the glare from a pair of headlights flashed across the garage windows and Gus heard a car stop. A few seconds later, the shop door slid open slowly. It was Jerry Corcoran, a broad grin on his face.

"You look like you swallowed something more than a canary," Gus greeted him.

"Gus, our case cracked wide open about a half hour ago," the Sergeant announced. "The suspects confessed."

"How'd you get 'em to do that?"

Jerry shoved his hat on the back of his head and perched himself on a corner of Gus's bench.

"Well, after you left the barracks this afternoon I decided to have a look at that road-gang shack, so I called up the road-commission office and got the key. Then a couple of the boys and I drove over."

Gus listened intently, stoking his pipe with shreds of tobacco.

"But the key they gave us didn't fit the lock at all," Jerry continued. "We looked through the windows and the place looked completely empty, but just to be safe, we pried the hasp loose and opened the doors for a look."

"Find anything?" asked Gus.

Hunches Hit a Three-Bagger

"Nothing except a burlap sack stuffed with more than eight thousand bucks in bills, a hydraulic garage jack, and a blood-stained tire iron hidden under some loose floor boards," grinned Jerry. "Those birds had planned to cache the money there until the heat was off and they were released. They'd even changed the lock. But thanks to your hunch, we not only got the money but the murder weapon as well, complete with fingerprints."

Gus grinned a satisfied grin.

"Tell me, Gus, what in the world ever gave you that hunch?"

"Remember that car with the knocking engine that I said shouldn't knock?"

Jerry nodded.

"Well, after making all the usual tests, I decided that the knock wasn't in the engine at all, but had something to do with the movement of the engine on its rubber mounts," explained Gus. "So I started to get underneath for a look. As I did, I just happened to notice that the car had snow

[*Continued on page 248*]

Take a Tip From American Airlines!

USE DEPENDABLE

CHAMPION

Spark Plugs

BE A CHAMPION DRIVER

. . . Good Spark Plugs are the Key to More Power!

Airline pilots know that the ability to get maximum engine power at a given moment is the greatest single safety factor they have. That's why 95% of the airlines fly with Champions!

Maximum engine power for passing is also a safety factor in driving. If your car lacks power, take American Airlines' word for it and install new Champion Spark Plugs.

"*AMERICAN AIRLINES* requires spark plugs that give maximum power, economy and dependability. Naturally, then, dependable Champion Spark Plugs are the approved standard for our fleet."

(signed) M. G. BEARD
Chief Engineer
American Airlines

CHAMPION SPARK PLUG COMPANY, TOLEDO 1, OHIO

Listen to the CHAMPION ROLL CALL . . . Harry Wismer's fast sportscast every Friday night over the ABC network

BUILD A BUNKROOM

REMODEL THE ATTIC

with the WESTERN PINES*

Rugged, he-man quarters for your young buckeroos are a cinch to build with colorful, easy-to-work Western Pines*. Or turn an idle attic into a cozy and hospitable guest room by building double-deck beds of these attractive, economical woods.

The smooth textures and straight, even grain of the woods of the Western Pines*—the wonderful way they grip paint, stain or wax—make them a joy to use on any workshop project. Cabinets, bookcases, tables, built-in fixtures for kitchens or rumpus rooms take on beauty and character from these glowing woods. They have long been favorites with home craftsmen who take pride in turning out a variety of useful and attractive home furnishings.

SEND FOR FREE IDEA PACKET No. 452!

Shows you how, with a little planning and ingenuity, you can work wonders all through your home with the versatile Western Pines*—and have fun doing it. Contains new, colorful illustrated booklet, "Enchanting Homes of Western Pines," "Bunk Bedroom Details," "How to Treat Knotty Pine Paneled Walls," etc. Write to Western Pine Association, Dept. 452-L, Yeon Bldg., Portland 4, Oregon.

These are the Western Pines
* IDAHO WHITE PINE
* PONDEROSA PINE
* SUGAR PINE

Gus Parlays a Pair of Hunches

[*Continued from page 246*]

tires and one of 'em was on the wrong way."

"Clue, or rather hunch, No. 1," put in Jerry.

"Right. Now, it also happened that the car belonged to Ed Johnson—the road engineer for this district. And that made me think of that old road-gang shack down near Trayton's."

"By the way," asked Jerry, "did you solve the mystery of Johnson's knocking engine?"

Gus reached over on his bench and picked a small stone. "Found this bedded in a mixture of dirt and road tar on the motor cradle," he explained. "When the engine rocked on its rubber mounts during uneven idling or when it was stopped or started, the engine hit the stone and caused what sounded like a knock. Soon as I pried it loose," Gus added, holding up the out-size pebble, "the 'knock' disappeared."

"Always play your hunches, don't you, Gus?" grinned Jerry.

"Have to in this game," confessed Gus. "Just between you, me, and the gas pumps out there, finding out just what ails a hunk of machinery pretty often is about three-quarters hunch and one-quarter know-how."

"Plus following all your hunches through," added Jerry. END

My Most Ingenious Solution

Well, I finally found another use for beer. What do you think it is?

While driving in the country, I was stopped by an electrical fire in the engine. I was stuck for a fire extinguisher until I remembered a few bottles of beer I was bringing home. I took the cap off one, shook it up, and then squirted it on the fire. That put it out.—George Rutkoski, Sugar Notch, Pa.

HERE'S HOW YOU DO MORE JOBS with a DELTA® DRILL PRESS

Only Delta offers so many extra-job accessories!

Shown is a Delta 17" Drill Press, one of 144 different models Delta offers in 14" and 17" sizes.

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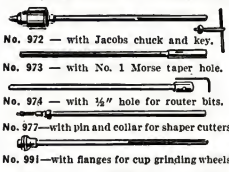
A SPINDLE FOR EVERY JOB

You can change the spindle on your Delta Drill Press, equip it to do more jobs.



No. 972 — with Jacobs chuck and key.

No. 973 — with No. 1 Morse taper hole.

No. 974 — with ½" hole for router bits.

No. 977—with pin and collar for shaper cutters.

No. 991—with flanges for cup grinding wheels.

DRILL IN WOOD

Delta gives you a wide variety of sizes of chisels, bits, bushings for mortising; plug cutters, for cutting dowels, etc. Do straight boring, angle boring, counter-sinking.

DRILL IN METAL

Using standard holding and clamping fixtures, you can countersink, tap, drill large holes, small holes — in round stock, thin or heavy metal.

CUT THOUSANDS OF SHAPES

Delta No. 980 Three-Lip Cutter Set makes your drill press a Shaper. You can cut mouldings, picture frames, thousands of shapes.

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Using Delta No. 974 Spindle with Delta Router Bits, you can rout curved work, rout with pattern, cross-rout, rabbet, make round-end mortises, flute, cut rosettes.

SAND CURVES ACCURATELY

Delta offers a big selection of sanding drums and sleeves for pattern sanding and freehand sanding of irregular curves.

MAKE MORTISE AND TENON JOINTS

Delta No. 976 Mortising Attachment converts your drill press into an accurate mortising machine that saves time and money.

DO MANY OTHER JOBS

Drill glass, slate, marble, paper. Mill, carve, surface, spin rivets, flute and reed turnings, cut disks, cut tenons, mix paint, do engine finishing, point dowel rods, polish and buff, etc.

"HOW-TO" BOOKS

suggest what to make, tell how to make it — in clear words and pictures. Available from your nearby Delta dealer, as part of his complete "one-stop" service on power tools and accessories. See him, to get the most out of your power tools—take on new jobs — have more fun — make new profits!

Look for the name of your Delta dealer under "Tools" in the classified section of your telephone directory.

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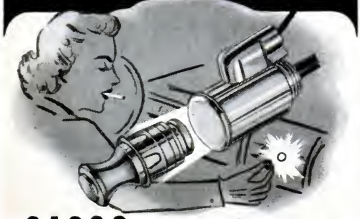
NO CAR SHOULD BE WITHOUT ONE!



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CIGARETTE LIGHTER

Why be without the convenience of this great new Vis-O-Lite illuminated lighter that makes driving safer day and night? You can replace your old lighter with a new Vis-O-Lite in a matter of minutes with pliers and screwdriver . . . and get the advantages of an illuminated lighter—well that ends fumbling in the dark, prevents scratching dashboards. Made by the manufacturers of the original pop-out lighter that's standard equipment on 4 out of 5 cars. Costs only **$2.75** complete. The illuminated well-assembly alone (minus the pop-out unit) costs only **$1.25.** Now on sale at Car Dealers, Auto Supply Stores and Service Stations.

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LOWEST PRICE EVER... *for a*

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A complete, practical power-workshop for craftsmen, hobbyists! Has accessories to drill, cut, etch, carve, grind, buff, sand, engrave and sharpen — metal, wood, glass, leather, plastic and fibre. 1001 year-round money-saving uses. AC and DC. *At Dept., Hardware, Appliance, Jewelry Stores.*

WRITE FOR NAME OF NEAREST DEALER

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CASCO

Mechanics of Farming

By Ladd Haystead

■ Grassland farming means better pasture grasses and legumes, more forage production, utilization of grass silage. But animal droppings on pastures have caused headaches. Plant life under the droppings tends to grow rapidly and form clumps, making an uneven surface that breaks implements. Now Fuerst Bros., 87 Nassau St., New York City, have imported a Scotch harrow called Homer's Flexible Tine that distributes the droppings, eliminates clumping.

■ Carried like a bazooka, the new one-man, portable, heavy-duty elevator shown in the photo below first takes on the job in the field of loading grain trucks. Then you can

carry it in and use it to transfer the grain from truck to barn loft. Made by the Belt Corp., of Orient, Ohio, it is powered by either gasoline or electric motor, has a 20-foot reach, digs into grain without scooping, and can handle up to 600 bushels per hour of corn, oats, or soybeans.

■ The Guide Lamp Division of General Motors offers a new dual-purpose light for tractors that gives a flood of light for attaching implements, and also a red rear light for safety when moving on the highway.

■ Tractor tires, almost from their introduction, have been weighted with water to provide traction. B. F. Goodrich Co. comes up with a

KEEP YOUR CAR OUT OF THE DANGER ZONE

When oil-pumping starts in your car, you can be pretty sure your piston rings are wearing out. And, unless you replace them, you can be *very* sure you are headed for costly Danger Zone No. 3.

Piston rings are designed to take the wear—to be replaced again and again—to save your engine.

So, when your car first needs new rings, ask your motor specialist to replace them with Hastings Rings. They are engineered exclusively for replacement service. They *stop* oil-pumping, *check* cylinder wear, *restore* performance. The more you delay, the more you pay. Hastings Manufacturing Co., Hastings, Michigan. Hastings Ltd., Toronto.

HASTINGS

FREE! Write for Danger Zone Booklet. It shows you how to save money on engine repairs.

STEEL-VENT PISTON RINGS

SANDS FASTER
Than 10 Pairs of Hands!

PORTER-CABLE Guild SANDER

Weighs Only 9 lbs.

only $62.50

Speeds Paint Removal . . . Used to be tough and messy to remove paint and varnish — not any more! It's easy with this powerful motor and high belt speed working for you.

Plane-Sands Faster . . . Another job made easy. The Guild A-2 Sander is perfect for taking off stock to close dimensions.

A Whiz at Preparing for a Finish . . . Always a uniformly fine, velvet-smooth surface. No waves or swirls — levels perfectly—cleans blemishes! And that's not all!

Speeds Screen, Sash and Door Fitting . . . And does a workmanlike job that will amaze you.

• Guild Sander does that job *fast* without hand-sanding drudgery! No bearing down — the powerful motor insures effortless, efficient cutting. So light, so perfectly balanced, Guild handles easily in *any* position. High speed abrasive belts have a variety of grits for work on wood, composition, plastic, metal, glass. Handy bench stand (extra) converts Guild Sander to a tool grinder—and to a machine for truing and smoothing butt and mitre joints.

Bench Stand

See your dealer for free demonstration. It'll open your eyes. Send in coupon today.

Send me literature on the Guild A-2 Sander and Bench Stand. Also name of my nearest dealer

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Address .....

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PORTER-CABLE MACHINE CO.
6082 N. Salina St., Syracuse 8, N. Y.

new one that provides for a cushion made of resilient rubber on the base portion next to the rim. Claim is it eliminates the bouncing caused when the water-fill is used alone.

■ University of Georgia announces a hybrid cotton that may have the vigor, yield, and other valuable characteristics of hybrid corn. Large-scale commercial production is not expected at the moment.

■ Pentachlorophenol, a fence-post spray well known to farmers, has a new use: hastening ripening of soybeans. The chemical knocks leaves off plants, permits light and air in, dries beans out faster, speeds up harvest two weeks. University of Illinois, where usage was developed, says the new method will provide earlier marketing and better prices, and allow time to plant a winter cover crop to cut down erosion.

■ An out-of-sight steering wheel--behind and under a hood--is offered by Oliver in a new tractor model for use in orchards. Nothing protrudes to catch and injure the trees.

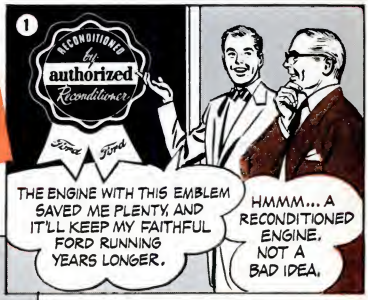
■ Stonecliff Farm Dairy, Bradford, Vt., announces they sell milk that not only is not touched by human hands, but isn't even exposed to open air. The milk is taken from each cow by a vacuum milker, goes through pipes to a strainer unit, and down to a stainless-steel collector tank under 300 pounds pressure. After passing through a pasteurizing steam jacket, it is cooled by ice water, and the tank swung to a bottling machine. It is claimed the milk has the same flavor as if fresh from the teat.

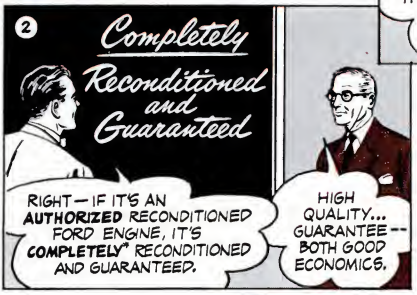
■ When industry doesn't provide new tools, farmers make their own. Howard Morgan, young Oregon rancher, was shocked at the price of $1 per unit for a fence post on-the-site. So he built a derrick that could be mounted on his tractor, added a 400-lb. pile-driver hammer. Cost--$225. Powered by the extra drum of a bulldozer control, the rig set 650 regulation seven-foot posts, two feet deep in clay soil, in first week. With an outlay of $40 for hired labor and $10 for tractor fuel, the machine paid for itself in one week.

"Go to the head of the class!..."

That's what my Economics teacher said when I showed him how to solve his problem.

THE PROBLEM:
Find the true economical way to make a high-mileage Ford run like new again.





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*Crankshaft, camshaft, bushings, valve guides, timing gears, pistons, rings, bearings, rods, valves, gaskets, studs, nuts—all completely reconditioned or replaced with Genuine Ford Parts. All work done to exacting Ford standards by authorized experts.

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Here is a steady repeat CASH business you can start at home in your basement or garage, while you are working at your regular job. No experience is necessary to turn out perfect cutting saws —"the first saw I sharpened came out 100%. I think the Foley Saw Filer is a marvel of perfection," writes Clarence E. Parsons. Every saw you sharpen will bring you new customers. You will find you can make up to $2 or $3 an hour—$20 to $30 a week in your spare time as a starter.

With a Foley Saw Filer you can file all hand saws, also band and cross-cut circular saws. It is easy to operate—simple adjustments—no eyestrain. Patented jointing principle evens up all irregular teeth and makes an old saw cut just like new.

This Free Book Shows How to Start

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shows you how to get plenty of saws to file without canvassing, and how you can develop into a general repair shop that will be your own business. This is a helpful, practical book that tells just what to do—send for your free copy today. No salesman will call.

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Send me free book **"INDEPENDENCE AFTER 40!"**

Name.....

Address.....

Toy House Fits Over Card Table

THE playhouse shown above is actually just an oversize paper bag that is unfolded and placed over a standard card table for support. Doors, windows, and realistic details are printed directly on the heavy flameproof paper. The KeKo Manor playhouse, which retails for less than a dollar, is made by the Kennedy Car Liner and Bag Co. of Shelbyville, Ind. Unless play gets too rough, the house can be refolded for re-use.

New Glass Skis Glide Smoothly

GLASS fibers are molded with plastic to replace the traditional wooden runners in new skis developed by the Northland Ski Company. In addition to great strength, Glas-Skis are said to have complete freedom from twisting, checking, and warping—all drawbacks of the conventional hickory runners. Camber, or slight longitudinal arching, is permanently molded in. Another feature claimed for these skis is that they are not affected by extreme changes in temperature.

NEW Low Cost QUALITY Tools!

ANNOUNCING Atlas WORKSHOP TOOLS AMERICA'S NEW VALUE STANDARDS

Now Every Family Can Enjoy the Fun and Savings of a Power Tool Home Shop!

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These are the first low-cost *quality* tools. If you have long wanted precision tools for your shop, but haven't wanted to spend the money for large machines, these Atlas Workshop tools will suit you to perfection. All the skill of Atlas' 40 years of precision engineering has gone into the development of Workshop tools. They give your shop *greater* versatility at *less cost* than any tools or combination tool on the market — *and all 5 can be powered with 1 motor!* See them today at the store of any Atlas or Atlas-Power King dealer. Send the coupon for complete catalog.

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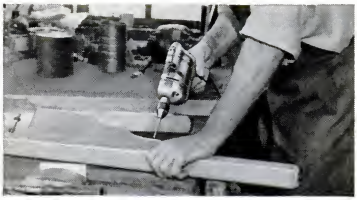

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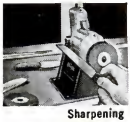
Zip through these home jobs with a HOME-UTILITY 1/4" Electric Drill only $22.95 (complete)



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Refinishing Furniture

Shining Pots, Pans

MR. FIXITS, HOUSEWIVES: This Home-Utility 1/4" Drill is the workin'est tool you've ever seen! It's a handy fistful of power for installing hardware and fixtures; sanding down furniture; sharpening cutlery and tools; polishing cars, silverware and woodwork; shining up pots and pans; waxing furniture; knocking off old paint and rust; light grinding! Drives scores of attachments. Weighs only 3¼ lbs. Over a million sold. Quality-built by BLACK & DECKER, world's largest electric tool maker! Sold at leading hardware, appliance, implement, department stores. *Try One Today!*

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SANDER-POLISHERS • BENCH GRINDERS
½" DRILLS • TOOL KITS • LECTRO-SAWS

POWERFUL! PORTABLE! POCKET-SIZE!

BULL HACKSAW only $4.95

Fits any 1/4" electric drill or drill press. Weighs only 11 ozs.; small in size—easy to carry, easy to use. 2-to-1 ratio of drill speed to saw speed for extra power! No gears, no bearings, nothing to wear out. Full chip clearance on any wood, metal or plastic stock up to 3/4". Powerful, portable, pocket-size—a must for every home craftsman, only $4.95.
LIFETIME GUARANTEE: At any time, we guarantee to put this tool in perfect working order for a handling charge of 75c.

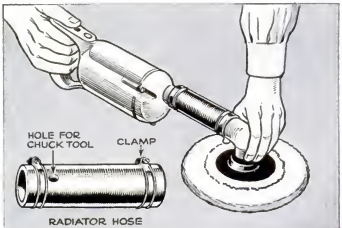
BERTRUM F. ENGINEERING & SUPPLY CO.
3121 Main Street Kansas City, Mo.

Wall Outlets for TV Antenna Leads

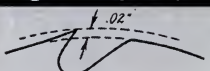
FLUSH-MOUNTING wall sockets for concealed TV antenna wiring are now available for use with single or multiple antennas. The model pictured below contains a switch that connects any one of three lead lines to the receiver. Other models provide connectors for antenna rotators. All types fit standard electrical outlet boxes. They're made by Mosley Electronic Specialties, Overland, Mo.

Hose Guards You from Drill Head

I GOT quite a wallop on the hand recently when I was using an angle-head buffer on my electric drill. I let go the buffer while the drill was still running. The buffer whipped around and the angle head hit my left hand. Now when I use the outfit, I slip a piece of radiator hose over the spindle and drill chuck and secure it with two clamps. This keeps the angle head from rotating when you take your hand off it. I made a hole in the hose so I can get in with the chuck key.—*Marion L. Rhodes, Knightstown, Ind.*



amazing new SAFE circular saw blade!



What the PTI "Cut Control" Blade Is:

Each PTI Saw Blade has only 8 teeth instead of the customary 100. These teeth are entirely different from the conventional saw tooth — they project only 20/1000" above the non-cutting edge. Thus the cut of each tooth is "controlled" by the non-cutting edge, in contrast to the ordinary saw blade where each tooth cuts right down to its base. This relatively simple alteration in design actually works miracles in the performance of the blade.

PTI CUT CONTROL

patent pending

Takes the DANGER out of circular sawing

Here is the greatest improvement in circular sawing — since the invention of the circular saw. It's the sensational new PTI Cut Control Saw Blade that brings long-needed safety and remarkable new efficiency to this important power tool. Never before has a saw blade been subjected to such gruelling, thorough tests, to such careful checking and re-checking by leading laboratories, government agencies, universities, and industrial concerns. And never before has a saw blade made such astounding records in safety and cutting efficiency. No other saw blade today can offer you so many exclusive advantages, including:

1. **Complete Safety From Kick-backs" — Since the teeth are only 20/1000" high — they cannot grab the wood and throw it against the operator — eliminating one of the most serious causes of circular saw injuries.**
2. **Reduced Direct Injuries — Cut Control teeth do not drag the hand into the saw. The non-cutting edge acts as an effective stop to cuts and limits their depth.**
3. **Cut Chips — Not Sawdust — Unique cutting action produces chips. Easier to clean. Eliminates fire hazard of spontaneous combustion.**
4. **30% to 40% Power Saving — Fewer teeth mean fewer cuts to achieve same results — hence less power consumption.**
5. **Longer Life Without Sharpening — When cutting off chips — the wedge action of the tooth does most of the work — which means less wear on the cutting edge of the teeth.**
6. **More Efficient Cutting — Each tooth is backed up better against body of blade. It is therefore more rigid, less likely to vibrate — and cuts more smoothly.**
7. **Quieter Running — Fewer teeth makes saw practically noiseless when running true.**
8. **Blade Does Not Crack — Blades are made of special Vanadium Steel. In addition — controlling of cut prevents overloading of teeth, a common cause of blade cracking.**

TESTED and APPROVED

The PTI Cut Control Saw Blade is the first and original blade of this type. (Patent Pending) Developed by one of the world's foremost saw makers — it has been thoroughly tested in leading laboratories and shops of both Europe and U.S.—with favorable reports in every instance. Letters from delighted users crowd our files:

O.M.W., Lima, Ohio: *"Without question the finest saw blade I have ever seen! Makes sawing a pleasure. Here's my check for two more."*

L.B.E., Winnipeg, Man., Canada: *"Was unable to cause a kick-back with it."*

R.E.O., Bainerd, Minn.: *"Never saw a blade cut wood like this. Will never use any other blade."*

ORDER TODAY

SATISFACTION GUARANTEED! OR MONEY BACK!

Here are the prices and sizes, delivered, postpaid. All blades are combination rip and cross cut. In ordering, be sure to give the diameter and bore of the blade. Send check or money order or we will ship C.O.D.

7" diameter blade	$4.95
8" diameter blade	$5.90
10" diameter blade	$7.50
12" diameter blade	$9.40
14" diameter blade	$11.40
16" diameter blade	$14.40

(Prices on carbide tipped blades furnished on request.)

PTI

INCORPORATED Dept. PS-2

401 Broadway, New York 13, New York

Gentlemen: Rush me the following units:

Quantity	Blade Diameter	Blade Bore

Please check:

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Don't pay several hundred dollars more than necessary when you build a home! Buy direct from our mill at our low factory price. We ship you the lumber cut-to-fit, ready to erect. Paint, glass, hardware, nails, etc., all included in the price—no extra charges. Plans furnished—also complete building instructions. No wonder our customers write us that we saved them 30% to 40%. Easy terms—monthly payments.

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Handsome Big CATALOGUE

Pictures wonderful homes in colors at money-saving prices. Designs to suit everyone. Send 25c for catalogue today.

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NEW WOOD SHAPER TOOL

ATTACHES TO DRILL PRESS-DOES ROUTING TONGUE & GROOVE-NOTCHING INLAY—PLUS ANY TYPE OF JOINT

Make window stiles, cabinets, doors, etc., in your own workshop. New, Low Cost Wood Shaper Tool attaches to your drill press—no expensive motors or benches. Complete unit costs less than having one shaping job done out. Write for FREE information.

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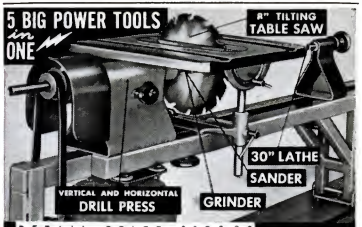
VARIABLE SPEED HYDRAULIC POWER TRANSMISSION

It has Infinate Speeds 0 to 550 Reverse Automatic Overload Protection; Adjustable Torque up to 180 inch pounds. 5/8" Input and Output Shafts. It will handle 1/4 to 1 1/2 H.P. Motor. Case measures 7 1/2" long 7" high 6 1/2" wide. VALUE OVER $300. Shipping Wt. 25#. On C.O.D. Orders we require a 10% Deposit.

only **$54.50** Fob. Chicago

DIRZIUS MACHINE SHOP "W" 1423-25 So. 52nd Ave., Cicero 50, Ill.

5 BIG POWER TOOLS in ONE



RETAIL PRICE $125.00

FACTORY TO YOU $59.95

SUPERSHOP the PRECISION BUILT WORKSHOP. Lifetime lubricated **BALL BEARINGS. All** running parts precision **GROUND.** Compare finest production tools. **BIG** capacity. Amazing **VALUE. Write for FREE catalog, full details, trial plan.**

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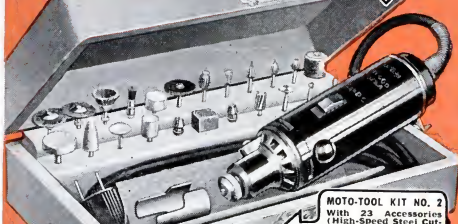
MOST PRACTICAL TOOL YOU COULD EVER OWN!

DREMEL *Electric* MOTO-TOOL

THE "POCKET-SIZE MACHINE SHOP"

GRINDS, DRILLS, ROUTS, CARVES, ENGRAVES, CLEANS, POLISHES, FINISHES

Approx. 27,000 RPM



MOTO-TOOL KIT NO. 2
With 23 Accessories (High-Speed Steel Cutters, Grinding Wheels, Polishing Accessories) $23.50

MOTO-TOOL NO.2 with one emery wheel point $16.50

Great for Hobbyists — Saves Time and Labor

ONLY DREMEL MODEL 2 GIVES APPROX. 27,000 R.P.M.—CONSERVES CUTTERS

It's the fastest, most powerful tool of its kind! Preserves cutters by cutting cleaner—faster. Works well in wood, plastics, metal—for drilling, carving, engraving, buffing, etc. For model-making it's a *must*. For home maintenance and repair jobs you'll wonder how you ever got along without it. And for general all-round workshop operation it's a tool every craftsman finds indispensable.

We urge that *you* try Moto-Tool on Dremel's 5-day money-back offer. Buying the complete Kit No. 2 saves money and opens the door to years of profitable results.

CHECK THESE MOTO-TOOL FEATURES

- Oil-less, sealed bearings . . . Pat'd. automatic chuck lock pin . . . Oversize armature shaft, hardened, ground, polished . . . Shockproof, bakelite housing.
- Dust filtered, air cooling system . . . Dynamically balanced armature . . . Handy hanger hook.
- Sturdy 110-120 V. AC-DC motor . . . weight only 13 oz.
- A precision tool widely used in industries like Ford, G-E, Remington-Arms, Nash-Kelvinator, etc.

IMPORTANT

Don't confuse Moto-Tools and Accessories with so-called "bargain offers". Compare Dremel, feature for feature, with any make. If Dremel products are not superior in every way, we don't want you to buy.

PORTABLE DRILL PRESS

Add further versatility to your Moto-Tool with this 12" high drill press. Just right for creating costume jewelry, model making, carving, routing, drilling, etc. Utilizes No. 2 Moto-Tool, which can be raised, lowered or swung in any direction. Weighs 3½ lbs.

ONLY $9.95 (Less Moto-Tool)

FUN FOR BOYS FROM 8 TO 80

DREMEL *Electric* COPING SAW

CUTS SCROLLS LIKE MAGIC—SANDS AS IT SAWS

BLADE FACES 4 WAYS

FREE PROJECT PLANS

JUST GUIDE IT!

Only $5.85 with 3 saw blades

SAFE! AS A HANDSAW

For home, hobby, repair work—no other tool pleases so much for so little cost. Works in any direction—delivers 7,200 strokes per minute smoothly, effortlessly. Saws through ¾" medium-hard wood at a foot-a-minute speed. Touch-of-the-trigger, foolproof action. Only 2 moving parts, never needs oiling. Uses 110-120 v. A.C.

. . . for 6 useful projects packed with each saw.

BIG VALUE!

MOTO-TOOL KIT NO. 1

Contains the lighter Model No. 1 Moto-Tool and 34 practical accessories (steel cutters, grinding wheels, etc.) in attractive lacquer-finish wood case $17.50

MOTO-TOOL NO. 1 w. hone emery wheel point $9.85

WHERE TO BUY DREMEL TOOLS

Dremel Tools are sold everywhere. If your dealer cannot supply you, send remittance in full and we will ship postpaid. Or send only $2, and pay postman balance plus postage and C.O.D. fee. **Money back if not delighted after 5 days' trial.**

DREMEL MFG. CO., Dept. 121-B, RACINE, WIS.

$$$ extra profits for you each month with..

Hobart 200 Amp. Portable Gas Drive D.C. Welder goes right to the job.

Set up your own welding business...get the big pay, extra profit jobs with this rugged, versatile welder that can't be beat for speed, durability, or performance.

Special features include 1,000 combinations of welding heat, positive control at or away from machine, outlet for supplying emergency power. Send for data.

Simplified **arc welding**

HOBART 200 Amp Gas Drive...world's best welder buy!

HOBART BROTHERS CO., Box P-21, Troy, Ohio. "One of the world's largest builders of arc welders"

$34.50

Sands, Cleans, Smooths, Polishes Electrically

Designed for industry, for professional work, this light, beautifully balanced, orbital-motion, SpeedSander is rapidly becoming a standard home appliance. With its powerful electric motor and all-ball-bearing construction, anyone can easily re-surface and refinish furniture, woodwork, metal surfaces or walls. It will quickly remove old paint, stain, or enamel down to the bare wood or metal; will sandpaper to a "piano finish"; remove rust and corrosion or "feather edge" a scraped fender. It will burnish pots and pans or with lambs wool bonnet, delicately polish fine furniture. It makes tedious, tiresome jobs fun—saves hands! In design, convenience and efficiency it is today's finest sander regardless of price. Ask your local dealer to demonstrate it.

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Speed Way MANUFACTURING CO.
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QUICK-ON, STAY-ON, SPEED NUTS®
NOW IN HANDY TINKER KIT

SPEED NUTS—famous throughout industry—now ready for home use. Ideal for repairing or attaching sheet metal parts on toys, appliances, etc. Kit contains over 100 parts—10 popular size nuts and matching screws. Replace threaded nuts and lock washers this fast, sure way. Tinnerman Products, Inc., Dept. 13(A), Cleveland 1, Ohio.

ONLY $1.00
Including Postage
CASH or CHECK ONLY

DUAL CROSS and ROTARY FEED

PALMGREN ROTARY, INDEX, MILLING TABLE

No. 83

Has 8" table, 360° movement and 4" cross feed travel. Adjusting wheels and dials graduated in decrees and thousands. Slotted for holding to table. No. 83 Priced $49.50. No. 82 without rotary feed $39.75.
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HANDY CALCULATOR FOR WOODWORKERS.. ONLY 10¢

Just set dial, quickly solves countless problems. Converts linear to board feet, compares workability of various woods, shows bit sizes, nail specifications. Also tool sharpening tips, etc. 6" diameter heavily varnished cardboard. Send 10c to Greenlee Tool Co. 2122 Columbia Av., Rockford, Ill.

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J. C. WHITNEY, 1917-F Archer, Chicago 16

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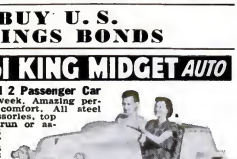
ALL NEW 1951 KING MIDGET AUTO

World's Lowest Priced 2 Passenger Car
Drive it for 75c per week. Amazing performance. Surprising comfort. All steel construction. Full accessories, top and heater. Ready to run or assemble it with our bolt together parts. Rider agents wanted, earn your car Free. Send 25¢ for detailed literature or $1 (refunded first order) for actual assembly book and service manual filled with photos, drawings, specifications, etc.



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JUST TWIST AND RAP! TWIST AND RAP!

IF YOU USE A SCREWDRIVER OR WRENCH YOU NEED AN . . .

HKP IMPAK DRIVER
U. S. PAT. PENDING

SENSATIONAL! FOR LOOSENING OR TIGHTENING NUTS, BOLTS OR SCREWS!

An amazing new development to save tempers and skinned knuckles . . . hours and dollars . . . for everyone who works on screws, nuts or bolts. Impakdriver translates the impact from a hammer's blow into a great amount of torque and starts ornery screws, nuts or bolts with unbelievable speed and ease! And it's great for loosening or tightening in hard-to-get-at places. A simple inexpensive tool, yet it beats the toughest problems and the worst time-killers. Belongs in every tool box . . . mechanics, machinists, repairmen, home handymen, hobbyists, everyone who uses screwdriver or wrench. Pays for itself on the first tough job made easy!

Sold in different set combinations with specially designed attachments for Hex sockets up to 9/16" and two sizes of Phillips and ordinary screwdriver bits.

See the Porter Impakdriver at your dealers or write for folder showing all details.

H. K. PORTER, INC., Somerville 43, Mass.
Porter Cutters — Porter Pruners
PORTER-FERGUSON Autobody and Fender Repair Tools

ALL BRAND NEW WAR SURPLUS BARGAINS! ALL FULLY GUARANTEED

HYDRAULIC CYLINDERS • AIR or OIL

Large supply of new labor-saving, economical hydraulic equipment in many types and sizes. Use these positive, highly efficient, smooth pressure hydraulics on presses, arbors, lifts, loaders, power control, positioning, brakes, plastic dies, auto frame alignment, etc., etc.

(Item #42)

ITEM #70—Purolator hydraulic oil filter. Permanent element type. 3/8" female pipe thread ports. Capacity, 16 gallons per minute. A $13.00 value. Now ......Postpaid **4.95**

ITEM #4—All steel double action hydraulic cylinder. 1 1/8" bore, 2 7/8" stroke. Clevis mounting. Will lift 1000 lbs. with 1000 P.S.I. line pressure. Perfect for positioning and feeding movements. Shpg. wt. 4 lbs. Postpaid.......... **4.95**

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ITEM #32—Double action. 1 1/2" bore, 9" stroke, will lift 1760 lbs. with 1000 P.S.I. line pressure. Wt. 4 lbs. A $45.00 value. Postpaid...... **10.95**

ITEM #41—Double action hydraulic cylinder, 2" bore, 6" stroke, clevis mounting at base and end of shaft. Overall length closed 12 1/2". Has 3/4" stainless steel shaft, uses 1/4" tubing fittings. Will lift up to 3100 lbs. with 1000 P.S.I. line pressure. Wt. 7 lbs. Postpaid **12.50**

ITEM #16C—Double acting hydraulic cylinder, 1 1/2" bore, 26" stroke. Will lift 1760 lbs. with 1000 P.S.I. line pressure. Weight 8 lbs. $55.00 value Now Only..........Postpaid **16.95**

ITEM #103—Double acting hydraulic cylinder, 2 1/2" bore, 17" stroke. Clevis mounting. Will lift 4900 lbs. with 1000 P.S.I. line pressure. 1 1/4" diam. shaft, 3/8" tubing thread ports. Overall length closed 28". Shpg. wt. 11 lbs. F.O.B. Chicago **21.50**

ITEM #31C—Double action hydraulic cylinder, 3 1/2" bore, 11" stroke. Aluminum alloy cylinder wall and all steel 1 1/8" diameter piston rod. Clevis mounting at base and shaft. 19 1/2" overall length closed. Will lift 9625 lbs. using 1000 P.S.I from Logan Heavy Duty Hydraulic Pump. Uses 3/8" tubing fittings. Value $102.00. Shpg. wt. 11 lbs. F.O.B. Chicago **22.50**

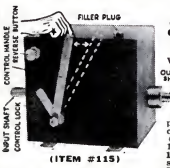
ITEM #6A—Double action hydraulic cylinder, 3" bore, 25" stroke, will lift 7070 lbs. with 1000 P.S.I. line pressure. Steel barrel. 1 1/2" stainless steel shaft. Gov't. acq. cost, $176.00. Shpg. wt. 26 lbs. F.O.B. Chicago........ **28.00**

ITEM #42—Double action hydraulic cylinder, 4" bore, 18" stroke. Rated lift capacity with 1000 P.S.I. line pressure is 12,560 lbs. Shpg. wt. 30 lbs. AN EXCELLENT BUY. F.O.B. Chicago............ **32.50**

HI-PRESSURE FITTINGS for cylinders and valves available at 50c ea. for 3/8" pipe and 65c ea. for 1/2" pipe.

HYDRAULIC SPEED REDUCER

WITH FINGERTIP CONTROL



(ITEM #115)

• Reamer Drives • Midget Cars • Feed Mills • Canning Machines • Conveyors • Lathes • Milling Machines • Motor Boats • Cream Separators • Garden Tractors • Pumps • Blowers, etc.

Variable output speeds ranging from 0 to input speed now available. Merely move control handle until desired speed is attained. Then turn locking handle to maintain the setting. Internal relief valves prevent overloading. Use input power of 1/4 to 1 1/2 H.P.

This Westinghouse-Oil Gear Unit converted to commercial use from 40 MM anti-aircraft traversing mechanisms consists of a variable displacement hydraulic pump feeding a fixed displacement hydraulic motor. These components are contained in a crackle-finish steel oil reservoir (capacity 2 qts.). Adjustable relief valves set at factory for 100 inch pounds of torque may be reset up to 180 inch pounds. Independent reverse control allows full output power and speed selection in either direction or rotation.

Both input and output shafts measure 5/8" diam., include keyway. Input rotation is counter-clockwise facing shaft. Recommended input speeds not to exceed 750 R.P.M. Overall dimensions 7 1/2"x7 1/2"x11 1/2". Gov't. acquisition cost, $428.00. Shipping weight 26 lbs. Complete with 2 qts. of oil and full instructions......................... Postpaid **54.50**

NEW! STATIONARY OR PORTABLE

D. C. ARC WELDER

250 AMPS. MODEL 252

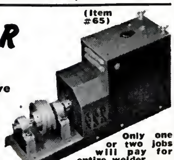
FOR ANY WELDING JOB, LIGHT OR HEAVY

Stop Costly Repair Bills, Weld It Yourself and Save

Designed for many years of trouble-free service. This precision engineered Direct Current ELECTRIC ARC WELDER is offered at but a fraction of its original value. It can be mounted permanently or easily transported for portable use. Does the job instantly where and when you need it. Has dial type rheostat for easy pinpoint control and a high-low range switch. Run Welder at 2500 RPM from drive pulley or power take-off of tractor, a 7 1/2 HP electric motor or a 10 HP gas engine. Use two V belts or flat belt (on pulley).

If more information is desired, write for Welder Circular!

(Item #65)



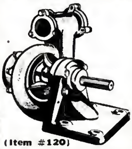
Only one or two jobs will pay for entire welder. Now...AT A FRACTION OF ITS VALUE. Price includes double V or flat belt pulley and instruction book. Shpg. wt. 107 lbs. F.O.B. Chicago **99.50**

GENERAL MOTORS-ALLISON

CENTRIFUGAL PUMP

200 GALLONS PER MINUTE

- FOR DRAINING BASEMENTS • FIRE-FIGHTING
- IRRIGATION • FUEL TRANSFER • SWIMMING POOLS
- HOME WATER SYSTEMS • DEWATERING


(Item #120)

This General Motors-Allison Centrifugal Pump—designed for use on U. S. Air Force Mustang fighters, now converted for commercial, home and industrial high volume pumping applications. Inlet—2 1/2" standard pipe thread, twin outlets 1 1/4" pipe thread—ball bearing supported 3/4" shaft. Easy, fast, simple priming. Rotation, counter-clockwise facing ahaft. Gov't. acq. cost $145.00. Shipping wt. 35 lbs. F.O.B. Chicago **39.50**

Suction Lift	Head Pressure	Gal. Per Min.	H.P.	R.P.M.
10'	65'	200	5.2	3500
10'	80'	40	1.5	2500

DIRECT CURRENT GENERATORS

For welders, plating, truck and marine use. D.C. appliances, lights, etc. Aircraft quality—lifetime grease sealed ball bearings. Heavy duty.

ITEM #89—Type M-2, rated 50 Amps.—24 Volts. Mfd. by Leece-Neville Co. Shpg wt. 32 lbs. Gov't. Acq. Cost $176.00. F.O.B. Chicago NOW ONLY **16.50**

ITEM #90—Type P-1, rated 200 Amps.—28 Volts, 2500 RPM. Mfd. by General Electric, Ford, Delco-Remy and Westinghouse, Gov't. Acq. Cost $300.00. Shpg. wt. 70 lbs. F.O.B. Chicago..... **22.50**

ITEM #91—Type R-1, rated 300 Amps.—30 Volts. Mfd. by Jack & Heintz. Gov't. Acq. Cost $380.00. Shpg. wt. 70 lbs. F.O.B. Chicago..... **35.00**

Each individually packed in wooden box.

Allis Chalmers MOTOR GENERATOR. 120 volt—60 cycle AC—7.82 amps. output. Input 24 volta, DC, 63 amps., 3600 R.P.M. Ideal for marine and aircraft installations, farm and factory use where AC is desired and DC available. Run unit off DC welder for handy 120 volt AC current for emergency power for oil burners, incubators, electric motors, etc. Shpg. wt. 200 lbs. An Outstanding Value. (Item #73) .......F.O.B. Chicago **79.50**

SELF PRIMING

ALL PURPOSE PUMP

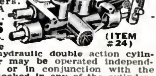
(Item #51A)

Ideal For:

- Draining Basements
- Insecticides
- Fuel Oil
- Vacuum Pump—28" for Milking Machines, Lab use, etc.
- Air Compressor—For paint spraying, etc. Delivers 4.5 CFM at 40 PSI with 1725 RPM
- Home Water Systems
- 4-Ball Bearings—1/2" Shaft—3/8" Ports
- Rotate in either direction
- Rated up to 8 GPM, 50 PSI
- Use with 1/4 HP motor or larger, speeds from 200 to 1800 RPM
- Useful for hundreds of applications in the home, farm and factory
- Built by Pesco—Div. of Borg-Warner. Gov't. acq. cost $45.00. Shpg. wt. 12 lbs.

Free: Complete instructions and performance data with each pump. F.O.B. Chicago. NOW ONLY **16.50**

HYDRAULIC CONTROL VALVE


(ITEM #24)

ITEM #24. Four-way control valve with built-in relief valve, for use with one double action hydraulic cylinder, may be used with 1500 P.S.1. hydraulic system to open and close hydraulic cylinders. Shpg. wt. 8 lbs. A $38.00 value. postpaid...... **9.95**

ITEM #26. Four-way control valve for use with two hydraulic double action cylinders. Each cylinder may be operated independently of the other or in conjunction with the other. Oil may be locked in any of the cylinders to hold the piston at any required position. Ship. wt. 6 lbs. A $60 value .... postpaid **12.95**

LOGAN HEAVY DUTY

HYDRAULIC PUMP

(Item #19)

For operating hydraulic cylinders and hydraulic motors on tractors, bulldozers, construction machinery, lift trucks, industrial applications, etc. Delivers 10 GPM at 1200 R.P.M. at 1000 P.S.I. using 6 HP. Has a 3/4" inlet, 1/2" outlet, 3/4" shaft with flat and keyway for direct or pulley drive. Has flange with 4 bolt holes for convenient mounting. Ship. wt. 22 lbs. Overall dimen.: 7" L x 5 1/2" H x 5 1/2" W. A $105.00 value. FOR ONLY.........F.O.B. Chicago **22.50**

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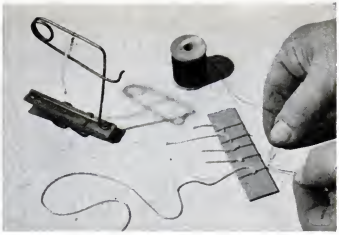


Self-Timer Set Off By Fuse

You can get into all the group pictures you take of your friends if you equip your camera with a simple self-timer like the one shown. A homemade fuse sets it off.

Make your timer out of a spring-type clothespin and a piece of clothes-hanger wire. Bend the wire to a spring shape as shown in the photos and form two eyes for screwing it into the clothespin. The spring trips the camera shutter when a fuse burns through heavy thread looped around it.

You can make fuses by soaking twine in a saturated solution of saltpeter (potassium nitrate) and letting it dry. Prepare thread loops by tying them around a cardboard template. The timer can be adapted to many types of cameras.—*Louis Hochman, Sherman Oaks, Calif.*

Half a Drill Set Saves Money

It's always handy to own a set of drills from 0 to 60, but a full set is expensive. A money-saving wrinkle is to buy just half a set comprising every other size from 1 to 59. I find that this selection fills the bill in practically every case. When tapping a small hole, for instance, the next larger drill size will still give good threads. If you can't buy half a set, buy a full set with a friend and split it up.—*Lauren McCready, West Redding, Conn.*

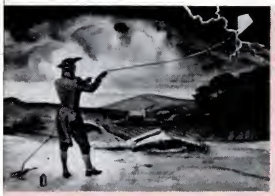
Let Oil Drain Back Before Checking

After stopping your engine, give the motor oil time to drain back into the crankcase before checking the level, if you want to get an accurate measurement. Five minutes isn't too long to wait.

ELECTRICITY LEAPS from storm clouds to top of Empire State Building as shown in this dramatic night photograph. Engineers harness electrical energy like this to "fire" gasoline in your engine.

Scientists Create "TAILORED LIGHTNING" For Better Motoring

In the great engineering laboratories of The Electric Auto-Lite Company in Toledo, Ohio, a group of Auto-Lite Ignition Engineers have been probing inside engine cylinder walls, peering at "blow-by-blow" spark performances, charting the behavior characteristics of man-made "lightning" across the spark plug gap. From endless tests they've determined what your engine's ignition system needs most, and then set about producing spark plugs to fill the bill. Net result: Ignition Engineered Auto-Lite Spark Plugs . . . the spark plugs that are *world famous* for quality and performance.

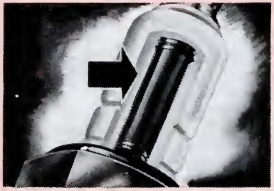


FRANKLIN'S KITE experiment was first demonstration of electrical nature of spark discharges between clouds. Date: 1752.

"FIRING PIN" of the car engine. Your spark plugs fire as many as 15,000 fuel charges per minute with tailored precision.

RELIABLE STARTING is one important benefi resulting from Auto-Lite research to assur correct materials, dimensions and design

RIVER CUTTING CANYON resembles way surging of electricity wears away electrodes. For solution see next picture.



TINY UNIT called a "Resistor" permits wider initial gap setting, makes possible these advantages of Resistor Spark Plugs:

All car, truck and tractor owners benefit from the exhaustive research performed by Auto-Lite Ignition Engineers . . . the men who design the coil, distributor, spark plugs, wire and all the other parts of the complete ignition system used as original factory equipment on many leading makes of America's finest cars and trucks. You're Always Right With Auto-Lite.

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750 WATT, 110 volt AC, 60 cycle, direct drive, air cooled, Briggs & Stratton gas engine, Delco AP. Pioneer generator, radio filter, self exciter, rope start. 190 lbs., 30" long, 17" wide, 16½" deep with carrying handle. New, stock #573 ..... **$199.50**

2500 WATT, 115 volt AC, 60 cycle, single phase, ENGINE: Briggs & Stratton, air cooled, 6½ HP. GENERATOR: Westinghouse or Leland, belt drive. Complete with $30.00 worth of spare tools, instructions and fully GUARANTEED. Was formerly priced at approximately $700.00. NOW priced for you NEW at only **$345.00**

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NEW **$279.00**

5000 WATT, 120 volt AC, 60 cycle, HERCULES 4 cycle gas engine. Generator manufactured by Hobart Bros. Unit includes remote control cable, 150' 2-wire #6, and 150' 3-wire #18, exhaust pipe, power cable plug. KVA at 80% power factor, radio and television filtered. Unit is completely automatic. List price today ..... $1900.00. Now priced for you at $675.00 ..... **$895.00**

used NEW **$995.00**

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$1995.00. NEW .....

35,000 WATT, 110-220 volt. Diesel. Rebuilt **$2995.00**

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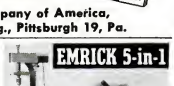

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7/16	13/32	01508	70c Ft.	Ft. 35c
½	15/32	01205	72c Ft.	Ft. 36c
¾	11/16	05001	91c Ft.	Ft. 46c
⅞	1-3/16	03125	1.01 Ft.	Ft. 50c
1	1-3/16	105	1.10 Ft.	Ft. 55c
1½	1-3/8	05015	1.74 Ft.	Ft. 87c
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- Brand new 110-volt, 60-cycle, 3000-4000-watt. Complete with tools, spare parts, battery, full instructions.
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Build portable hi-pressure (up to 150 lbs.) air unit. Basic kit consists best 1-cyl. piston compressor, stainless 12"x24" tank, 160-lb. gauge, genuine Brown paint spray gun, dust blow gun, tire chuck, 15' hose, fittings and manual "How to Build." Guaranteed $36.90

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0-250 amps. Easy to drive with tractor, engine, etc. Professional outfit. Ready to use. Built-in controls. $99.50

- Unit with G.E. helmet, rod holders, rods, cables, clamps, etc. $104.50 $300. value.

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- Weed spray equipment already hard to get. Buy at once. Or send for Weed Spray Bargain Catalog.

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- Everything new, unless otherwise stated. Satisfaction guaranteed.
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- Hundreds uses on farms, for business, contractors, etc.
- Guy — strengthen — gates, fences, buildings, wagons, etc.
- Ideal guy for television towers, many other uses.
- Cost Gov't. $1.10 ea.

SALE
10 for ..... $ 3.89
50 for 16.47
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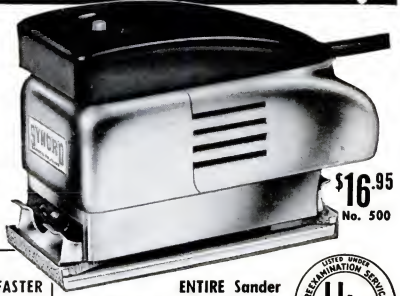

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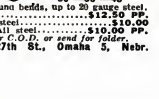

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21/64"—	.32	31/64"—	.55	15/16"—	1.65
11/32"—	.32	41/64"—	.90	31/32"—	1.80
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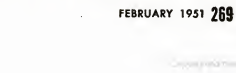

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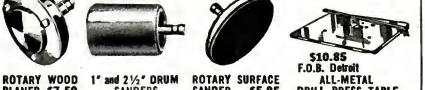

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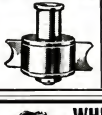

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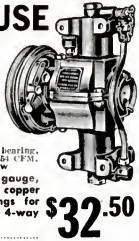

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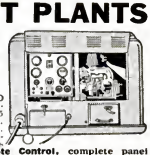


Brand New! War Surplus

Signal Corps Power Unit PE 197

115 volt 60 cycle A.C. single phase 5 K.W. Hobart water cooled 14 h.p. 4 cylinder Hercules engine. Remote Control, complete panel board with instruments, 150 ft. automatic remote control cable with reel; 150 feet 26 heavy duty wire with reel; housed in metal case with replacement parts and tools. Cable with reels alone worth $400. Regular price of unit $1900. Shipping wt. 1250 lbs. Our price, complete, f.o.b. Chicago **$895.00**

Same unit, slightly used, reconditioned. Fully guaranteed **$495.00**

less cable

2½ K. W. LELAND POWER PLANT **$295.00**

Brand New

Save nearly ½ on Gas Engines!

Red Seal Continental

6 to 1 REDUCTION GEAR
1 CYLINDER — 4 CYCLE

1½ HP with 6 to 1 reduction gear. Operates at 450 R.P.M. For lawn mowers, scooters, garden tractors, pumps, compressors, generators, etc. List Price $79.50. Shipping wt. 54 lbs. SPECIAL PRICE **$47.50**

AUTOMATIC COMPRESSOR UNIT

½ H.P. heavy duty capacitor motor, AC 110/220 volt, 60 cycle, 2x1¾ inch piston type compressor, splash feed lubrication, 12x24 inch tank, automatic pressure switch, CFM 2.8 at 100 lbs. pressure, or 150 lbs. pressure for intermittent duty. Check valve, safety valve, air regulator with gauge and filter. 20 ft. air hose with air chuck for inflating tires, V. belt drive. Mounted on 2 wheels, ball bearing, with 2"x10" pneumatic tires. Portable with handle. Shipping wt. 90 lbs.

SPECIAL PRICE **$98.50**
BRAND NEW

Same unit with Gas Engine **$107.50**

WELLWORTH V-BELT CLUTCH

Takes starting load off engines or motors. When speed is reached, a flip of handle shifts clutch from idling to driving position. Handles "A" belts, 2.35" pitch diameter, 5/8" bore. Ideal for use with lawn mowers, garden tractors, home workshop motors, etc. 3¼" long. Safe, easy to mount, sealed bronze bearings, positive action. Shipping wt. 3 lbs. **$7.50**

BUSHING FOR ½" SHAFT, 15c
SAME CLUTCH FURNISHED WITH ¾" bore $8.50

AUTOMATIC PRESSURE SWITCH

FOR AIR OR WATER

20 to 40 lbs. **$6.50**

125 to 150 lbs. with unloader **$13.75**
¼" check valve **$3.25**
½" check valve **$4.75**

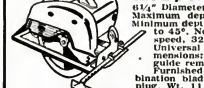
AIR REGULATOR AND EXTRACTOR

½" Air Regulator, Gauge and filter. Wt. 5 lbs.

New **$8.95**

Regulator and Gauge only **$5.95**
Air Filter only **$3.25**

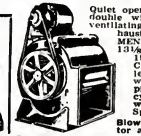
PORTABLE ELECTRIC HAND SAW



The Zip Saver With All the Features

6¼" Diameter saw blade, ½" square arbor hole. Maximum depth of cut 2⅛". (At 45°, 1⅜".) Minimum depth of cut ⅛". Angular adjustment 0° to 45°. No-load speed, 5200 r.p.m. Full load speed, 3200 r.p.m. Amperes, full load, 8.0. Universal AC-DC motor, 110/220 volt. Dimensions: 11¼" long; 9½" wide (ripping guide removed); 7⅛" high (without blade). Furnished complete with 6¼" diameter combination blade and 10 ft. cord and plug. Wt. 11½ lbs. Price **$39.95**

"WELLWORTH" BLOWER BARGAIN



BRAND NEW

Quiet operating, Double wheel inlet, double width blower. For heating, ventilating, cooling, air washing, exhausting and forced draft. DIMENSIONS: 10" wheel; outlet 13¼"x11⅝"; inlet 8¾". Height 19". Width 18". Depth 16½"; C.F.M., ¼" S.P. 1600; outlet vel. 1575; motor ¼ H.P. with overload relay; cord & plug 110 v. 60 cy. A.C. Ship. wt. 67 lbs. Special price ..

Blower less motor and drive **$47.50**

$27.50

CHICAGO PNEUMATIC RIVETER & CHIPPING HAMMER

CP4X Pistol grip handle. Takes up to 3/16" rivet. Weight 6 lbs. List price $72.50. **BRAND NEW** **$32.50**

Used, like new, guaranteed **$17.50**

Chicago Pneumatic Lever Type AIR DRILL

With ¼" Jacob Chuck. Wt. 2 lbs. List price $55.00. Only **$17.95**

6 FT. STOW FLEXIBLE SHAFT

Brand New

⅜" Core; Ball bearing handle and arbor. Operates on ¼ H.P. Motor at 1725 or 3450 r.p.m. $29.00 value. Wt. 8 lbs. **$16.50**

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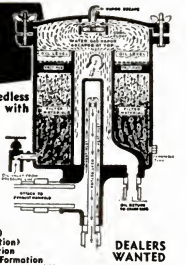

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HINGE MIX, No. 170H. 12 pairs of Strap and butt hinges, Hasps, 1" x 1" to 7/8" x 10" in length and 8" strap. 2 lbs. **1.09**

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FILE MIX – Ten assorted Files, 4" to 12", includes 3 Vixens, half rounds bastards, mills, etc., in seconds and used but in good condition. 1 Vixen alone worth our price for entire mix. F-1 **99c**

PULLEY MIX, No. PM-1 – You'll want this one around. 10 micarta & metal pulleys ranging from 1" to 5" with ball and one piece bearings. These are aircraft pulleys, the best made with 100's of uses. A WONDERFUL BUY!!! **2.95**

COUNTERSINK MIX, No. 168. Wide assortment. Excellent condition. High speed steel. Assortment of ten 100° and 110° with pilot sizes ranging from 3/32" to 3/16" No. CM-1 **2.69**

SCREW MIX – 5 lbs., Including assortment of wood and machine screws. Many sizes. Save dollars and alway have plenty of screws on hand. . **1.39**

NUT MIX NM-1 – 3 lbs. approx. 500 nut Anchor, Lock, Castle, Hex, Elastic Stop Nuts, etc. You'll always have plenty of Nuts in the shop. NM-1 **1.39**

SUPER COMBO MIX – No. SC2. Here's a real bargain. All eleven above mixes for ONLY **14.95**

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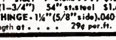
Rust resistent alloyed steel, extra flexible, pre-formed – 7x19 strand-on reels.

1/16"	4¢ ft.	7/32"	8¢ ft.
5/64"	4½¢ ft.	1/4"	9½¢ ft.
3/32"	5¢ ft.	9/32"	10½¢ ft.
1/8"	5½¢ ft.	5/16"	12½¢ ft.
5/32"	6¢ ft.	3/8"	13½¢ ft.
3/16"	7¢ ft.	1/2"	16½¢ ft.

Stainless Steel Cable		Bronze Cable	
1/16"	7¢ ft.	1/4"	15¢ ft.
1/8"	16¢ ft.	5/16"	19¢ ft.
1/4"	29¢ ft.	1/2"	36¢ ft.

PIANO HINGE



Overall Width		Length	Price Ea.
1¼"	(5/8" side)	72" alum.	$1.00
2"	(1" side)	9' alum.	$1.75
3½"	(1–3/4")	54" st.steel	$1.69

BRASS HINGE - 1¼" (5/8" side) .040 Any length at . . . . 29¢ per.ft.

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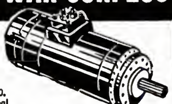
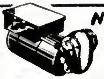


Here's a Real Buy! Finest precision built R-1 Generators, used on B-29's, cost the Government approximately $400.00. Gives from 300 to 400 amps at 27 volts. Ideal for all welding, light and heavy up to 5/8" thickness. FREE complete instructions for conversion of this Generator to welding unit. R-1 NOW AVAILABLE AT **27.95**

Other AIRCRAFT GENERATORS

P-1	27 Volts	200 Amps	15.95	E-5A	12 to 15 Volts	50 Amps	12.95
1273-1A	27 Volts	75 Amps	15.95	03	27 Volts	100 Amps	25.00

NEW! GEAR HEAD MOTOR



GHM-607 – Originally designed to drive large Aircraft Tow-Target reels. Powered by 24 VDC, 95 amp, compound wound motor. Rated at 2 HP. Turns 4,200 RPM and is geared down to 136 RPM at the power take-off shaft. 60 foot pound torque at take-off. Power drive is 3/4" female adaption. Unit has magnetic clutch for instant stop control. Comes complete with operating switches and control box. **37.50**

FIRE EXTINGUISHER

Kiddie Lux CO_2 Type. Built to Gov't spec. Shatter-proof, heavy case. Fully re-charged. with horn

No. 602A – 7½ lb. $35 Value. **19.25**
No. 603 – 10 lb. A $65 Value. . . **25.75**
No. 601 – 4 lb. Wheel Control Type **$14.25**
No. 605-B – 15 lb. Wheel Control Type **32.95**
No. 605-C – 15 lb. New. Squeeze Grip Type. $85 Value . . **39.95**

Note: Weights listed are capacity extinguisher charge.

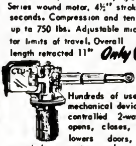
8 to 5 Gear Ratio or Direct Drive

NAVY WINCH

Here's a real PALLEY BARGAIN. Designed to hold, pay out, and reel in steel cable used in towing targets. Capacity 2500 ft. 1/8" or 4500 ft. of 3/32" cable. Has gear driven rotating drum, brake band on drum, ratchet and pawl to set brake, detachable crank handle for rotating drum. Size approximately 29" x 13½" x 13". **27.95**

ELECTRIC ACTUATOR

CTU-2 Foote linear actuator. 24 Volt A.C. or D.C., 8500 R.P.M., 1/6 H.P. Series wound motor, 4½" stroke in 13½ seconds. Compression and tension Loads up to 750 lbs. Adjustable micro switch for limits of travel. Overall length retracted 11" **Only 6.95**



Hundreds of uses for any mechanical device needing controlled 2-way action, opens, closes, raises or lowers doors, windows, gates, valves.

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AUTO PULSE PUMP – Ideal for fuel pump for auto or boat. 24 Volt D.C. Can be adapted to 6 Volt D.C. 1/8" standard pipe ports **5.50**

Sperry Aircraft Directional
GYRO COMPASS
Dial is 360° swing calibrated 1/10° (6 min). Panel Mount 4½" square with 3" luminous dial. Can be used in autos, planes, or boats by attaching one tube to intake manifold for required vacuum. Complete with reset caging knob. Gov't. overhauled – ONLY **$4.95**

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25" x 66" x 1½" thick. 8.95
25" x 60" x 1½" thick. 8.90
18½" x 20½" x 4½" thick. . . 6.45
35" x 21" x 6" tapered to 4". 11.95

SHEET FOAM RUBBER

3" Cored Stock . . . No. 2½ compression Ideal for cot, bed, bunk, couch or chair.
3"x44"x80" $59.50 3"x44"x49" $33.50
3"x22"x80" $33.50 3"x22"x40" $17.50

MOTORS

LEAR ELECTRIC MOTOR. 24 volt, 6 amps, series wound reversible motor with overload clutch. Motor turns 11,000 R.P.M. Has 11 to 1 gear reduction box turning 1000 R.P.M. at take-off. Adaptable to flex or rigid drive. Limit switch box. Size 10" x 4". **$7.95**

SAMSELL MOTOR 27 volts, 16 amps 1/5 H.P. reversible, series wound on motor. 3800 R.P.M., shaft 9/32" diameter. 12–spline. 4-1/8" x 2-3/8". ONLY **3.95**

G.E. GEAR HEAD MOTOR

Heavy Duty G.E. Gear Head Motor. 1½ H.P., 24 volt DC, 125 amp reversible motor will drive reduction gear box unit 44.5 to 1, resulting in 168 R.P.M. at 5/8" diameter take-off shaft. Motor contains electro magnetic break.

UNIT COMPLETE **10.95** MOTOR **4.95**
GEAR BOX ALONE **7.95**

LEATHERETTE

to cover Chairs, Patio Furniture, Nooks, Auto Seats, etc. 10 colors AT A BARGAIN PRICE.

Width	Colors	Price (per rn. yd)
36"	Tile Red, Brn, Black.	$1.19
36"	Lt.Grn., Dk. Grn., Blue.	$1.65
54" (approx)	Red, Brown, Light Blue, Ivory & Yellow	$1.95

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Water-proof and Heat Resistant plastic covering in Yellow, Chinese Red, Grey, Green, Chartreuse, Brown and Yacht Blue. Full 54" width. . . ONLY **1.95**

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Gives 20,000 lb. thrust (push pull) using 1500 PSI line pressure as obtained from our hyd. pumps. Or will produce 40,000 lb. thrust with 3,000 lb. line pressure. CAN ALSO BE OPERATED ON LOW PRESSURE AIR SYSTEMS. 4" Bore, 1½" dia. piston shaft, 18" stroke, length 30½". Equipped with ball bearing loaded clevis type mounting and swivel type high pressure steel pipe bracket for easy use. Ideal for road, farm & shop machinery, presses, etc. Cost Gov't $390.00 **27.95**

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Vickers Hydraulic Transmission

Self contained, 2 H.P. constant torque at all speeds with variable volume reversible, piston pump (controlled by outside lever) supplying piston hydraulic motor. Automatic pressure, dash pot for smooth control. Power output R.P.M. - 0 to 1/3 input R.P.M. in both directions. Input R.P.M. 1800 continuous 4000 intermittent. Dash pot can be removed for greater R.P.M. Ideal for Lathes, Duplicator Setup on Mills. Conveyors. Small Cars, Drives, Gearing, etc. **25.00**

4" Spline Shafts for input & power take-off . . . $2.50 pair.

VALUABLE GEAR BARGAINS

6 to 1 with screw shaft #111 . . . . $4.98
85 to 1 (can be used for radio, antennae, etc.) **$3.95**

GEAR BOXES VTG-1 – 90°, bevel gear 1½ to 1 reduction, size 7" x 6". A Life-time Value. **$3.95**

VTG-2 – Inline spur gear 16 to 1 reduction, thru 4 gears. Final take-off 4½" dia, 26 tooth. ⅛" Alum. spur gear. **$6.49**

Both above gear boxes have lever control for engaging & disengaging positive clutch. Dust proof housing. Prelubricated bearings. Both can be adapted to Vickers Transmission.

ELECTRONIC TRANSMISSION GEAR TRAIN

GT-1, approx. 50 Bronze Spur & Pinion Gears – 3/8" to 4" dia., 5 sets of 7 cluster gears, 2 complete worm and worm gear drive sets, 40 N.D. ball bearings ½" to 1½" dia., watch springs, bushings posts, face plates, housings–Micro Switches, 2 miniature controlled clutches, etc. Gears in multiple size & sequence, identical teeth ratio, giving 100's of gear reduction combinations. Wt. 19 lbs. **$8.49**

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World's Hottest Iron Value!

Two soldering irons in one with button heat control. Push the button—Select 150 or 300 Watt heat for light or heavy work. Complete with tip, bench holder, S'asbestos cord. U L approved. 110V AC. A $15.00 Value For . . . **3.95**

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Can be quickly attached to bench, table, sawhorse, almost any place where there's a small projection.

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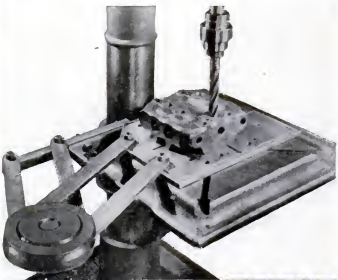
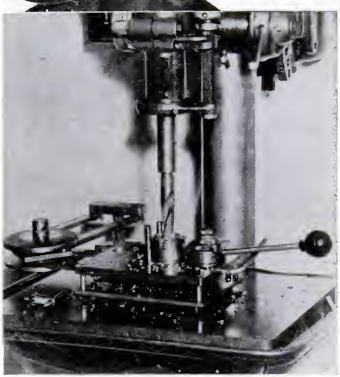
New





Torque Hazard Eliminated. This new drill-press attachment uses an ingenious system of moving arms to hold work steady. Although you can move the floating plate by hand anywhere on the drill-press table, the torque of the drill can't budge it. The attachment consists of two pairs of arms that are hinged in parallel on fixed centers at both ends and in the middle. Each set of arms is tied and hinged individually to the table at one end and to the plate at the other. In the upper photo, work is held by locating pins. In the lower photo, work is held on a cam locking plate against two pins. Torkarm Corp., Minneapolis, makes it.

Tools

Belt Sander Run by Electric Drill. Latest addition to attachments for your electric hand drill is this belt sander. It weighs 6 lb., is 8¾" long, and costs about $20. The price includes light-, medium- and heavy-duty pressure pads plus two belts—medium and fine grit. Garnet, aluminum oxide, and silicon carbide belts are available. Power is transmitted from drill to sander through gears. The maker is United States Industries, of Chicago.

Long Level. The maker of this 78" level, the Simplex Level Co., of Detroit, Mich., says it is the only one like it on the market. It's all aluminum, weighs 4 lb., and is priced at $10.85. It has adjustable, replaceable, metal-mounted spirit vials. Extra vials are 50 cents.

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GIL-BILT 10-INCH TILTING ARBOR SAW

- 27x28 in. table, 13½ in. capacity from front of blade
- 10 in. blade cuts 3¼ in. deep, tilts full 45 degrees
- Floor model 34" high table always stays level
- New Departure ball bearing arbor, ¾" precision shaft turned down for ⅝" bore blades, alum. housing, shipped ready to run
- Jackscrew and 4½ in. dia. handwheel lowers and raises blade
- Cast aluminum miter gauge and self-aligning rip fence guide

GIL-BILT Metal Parts Kit includes Plans, ball bearing arbor, miter gauge and bar, rip fence guide, dado insert, lock knobs, jackscrew mechanism and handwheel, and all other metal parts (less blade) $20.95
Same Kit with 10" Combination Blade..$24.90
Same Kit with 8" Combination Blade..$23.90

GIL-BILT BELT SANDER

- 84 sq. in. sanding surface. Over 4 times the effective area of a 10 in. disc sander.
- Belt operates in either vertical or horizontal position, does all sanding operations.
- Driver drum and pulley turn on sealed New Departure ball bearings; tension drum turns on Chrysler Oilite bronze bearings.
- Spindle and tension mechanisms of cast aluminum, completely machined and assembled.
- Belt travels 1800 ft. per min. Over a MILE of straight sanding action every three minutes. Saves more "elbow grease" than any other tool.
- GIL-BILT Metal Parts Kit includes Plans, ball bearing spindle, 4 in. driver drum, 3 in. tension drum, tension mechanism, table tilt segments, rubber tires, cloth sanding belt, and all other metal parts $16.95

GIL-BILT 12-INCH BAND SAW

- Cuts to center of 24 inch circle
- Handles stock up to 6 inch thick
- 18x18 inch table tilts 45 degrees
- Lower wheel and drive pulley runs on sealed New Departure Ball Bearings; Upper wheel runs on two ⅝" bore Oilite Bronze bearings
- Upper wheel tension and tilt mechanism of cast aluminum, completely assembled
- Upper and lower blade guides. Each has ball thrust bearing, self-lub bronze jaws.
- Rigid cast aluminum wheels fully machined ready-to-install. Heavy rubber tires.
- Uses standard 78 inch blades up to ⅝ in. wide.
- Fully enclosed mechanism for utmost safety.

GIL-BILT Metal Parts Kit includes Plans, rubber tires, aluminum wheels, ¼ in. blade, ball bearing spindle, tilt mechanism, blade guides, table tilt segments, and and all other metal parts. $20.00

Return Kits in 10 days for refund if not satisfied.
(Prices include postage within 600 miles. Over 600 add 2%)
Also available—Plans and Parts Kit for 8" Tilt/Table saw. Order Plans at $1.00 each—sent postpaid anywhere in the world or write for FREE descriptive catalog.

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ONE Tool Does 1000s of Jobs . . .

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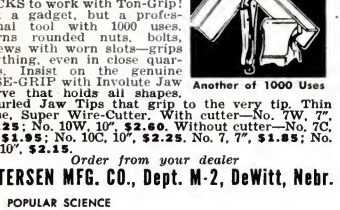

LOCKS to work with Ton-Grip! Not a gadget, but a professional tool with 1000 uses. Turns rounded nuts, bolts, screws with worn slots—grips anything, even in close quarters. Insist on the genuine VISE-GRIP with Involute Jaw Curve that holds all shapes. Knurled Jaw Tips that grip to the very tip. Thin Nose, Super Wire-Cutter. With cutter—No. 7W, 7", **$2.25**; No. 10W, 10", **$2.60**. Without cutter—No. 7C, 7", **$1.95**; No. 10C, 10", **$2.25**. No. 7, 7", **$1.85**; No. 10, 10", **$2.15**.

Another of 1000 Uses

Order from your dealer

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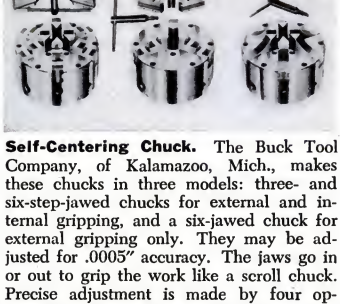
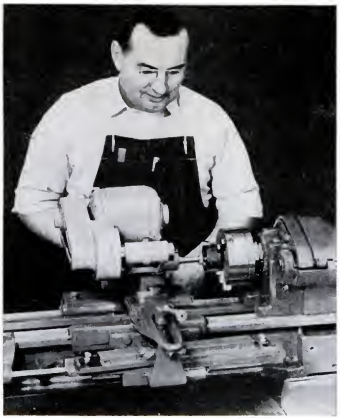
New Tools

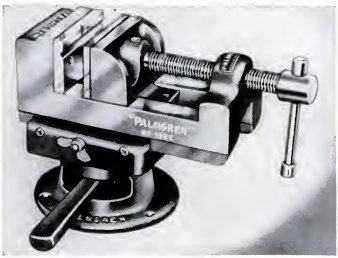


Self-Centering Chuck. The Buck Tool Company, of Kalamazoo, Mich., makes these chucks in three models: three- and six-step-jawed chucks for external and internal gripping, and a six-jawed chuck for external gripping only. They may be adjusted for .0005" accuracy. The jaws go in or out to grip the work like a scroll chuck. Precise adjustment is made by four opposed fine-threaded screws that operate between the chuck body and its adapter.

New Punch for Sheet Metal. Work is clamped in this punch and the specially shaped chisel used to cut out the hole. Use of the adapter ring lets you cut two sizes of holes on the same tool. The West Pacific Company, of Portland, Ore., makes the tool in various sizes, including models for round, square, and rectangular holes.



Internal Grinder Turns 30,000 R.P.M. This attachment for lathes and other machine tools is powered by a 1/6-hp., 3,450-r.p.m. AC motor. The motor is compound belted through an intermediate shaft to turn 30,000 r.p.m. The longest of the four arbors supplied permits grinding a hole 3⅞″ deep with a 1″ wheel. A ⅛″ chuck also is supplied so you can use mounted grinding wheels. South Bend Lathe Works, South Bend, Ind., is the manufacturer.



Combination Bench and Drill Press Vise. You can bolt this vise to a bench for general shop use, or you can mount it on the table of a drill press. It can be rotated 360° horizontally and locked at any point. The jaws are 2½″ wide, 1″ deep, and open to 2½″. The maker is the Chicago Tool and Engineering Co., of Chicago.

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P.S. Last minute news & notes...

DEADLIEST DRIVING in the world is done in Bombay, India, according to a world traffic survey made by the Danish Government. The annual fatality rate there is 769.66 per 100,000 cars and trucks. In Los Angeles (which has more cars per family than any other city in the world), the annual death rate in traffic accidents is only 27.86 per 100,000 cars; and in Milwaukee (the safest city in this respect) it is only 22.06 per 100,000 cars.

SYNTHETIC FROST can now be produced --another triumph of science over the weather. It is a chemical that has been developed in the Shell Oil Company's big agricultural research laboratory in California to aid cotton growers. If leaves get into cotton picked by machinery, they tend to discolor it. Jack Frost doesn't always nip them off in time. But growers no longer have to worry about them. They can apply this chemical to the plants now, and know that it will dispose of the leaves.

THE BIG BEVATRON being built at Berkeley, Calif., is half finished. It will be about 16 times as energetic as the most powerful cyclotron now running--Columbia's University's 380,000,000-volt proton accelerator. Protons shot out of the bevatron will travel almost as fast as light. Its builders hope to have it ready to be warmed up next year, but fear that the shortage of essential equipment will delay them.

EXHAUST GAS from an auto engine can now be made harmless. A catalytic device developed by Eugene J. Houdry, the petroleum scientist, takes both the poison and the odor out of the gases from engine to which it has been attached. It is being used already on fork-lift trucks in several large plants.

TELEVISION is being used to combat forest fires in South Africa. Pictures are broadcast from a plane flying over the flames. Officers directing the battle against the fire thus can see what's happening and rush men where needed.

ENGINEERING is one of the nation's fastest-growing occupations, and will probably remain so, says the U.S. Department of Labor. More young engineers will be needed in the next few years than now seem likely to be graduated.

AUTO MAKERS concerned about cold stalling have found it hard to prevent mechanically. This tendency of an engine to die repeatedly after being started in cool, humid weather is caused by ice in the carburetor. So Esso has added a water-soluble substance to its gas that works like antifreeze in a radiator. Results thus far are reported to be good.

A NEW X-RAY CAMERA with an optical system such as is used in giant telescopes has been developed by the Fairchild Corp. It can be used to take pictures of the thicker parts of the body six times as fast as was previously possible. And the new camera makes possible, its makers say, quick, convenient, and cheap checks for cancer of the gastric tract, similar to the mass tuberculosis surveys now made.

ACTH, the new miracle hormone that has aided sufferers from arthritis and other ailments, also has been used successfully now to counteract the poison of the black-widow spider and the copperhead snake. And Columbia University researchers are about to begin a three-year investigation of the chemical nature and method of attack of poison ivy.

HYDRAGUIDE, a system that draws on the engine to help you steer a car, will be introduced on some of the 1951 Chryslers, its makers report.

The Editors

This One

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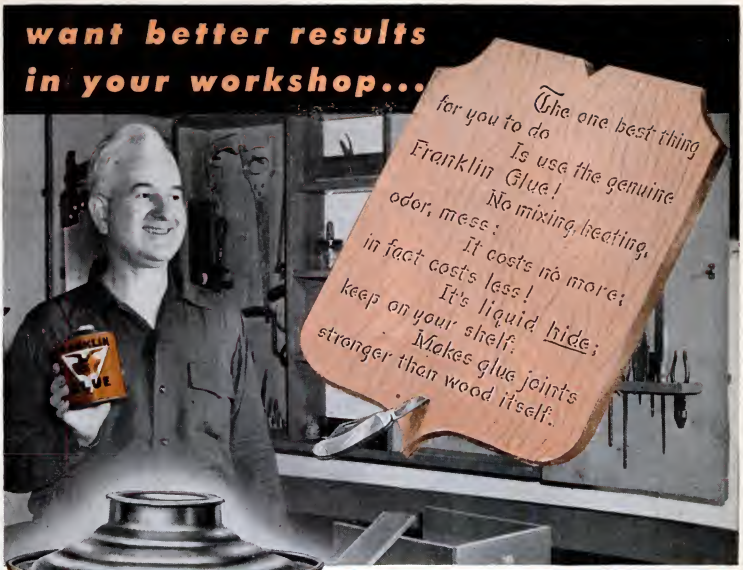
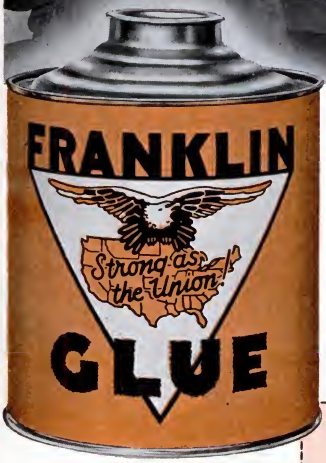
want better results in your workshop...





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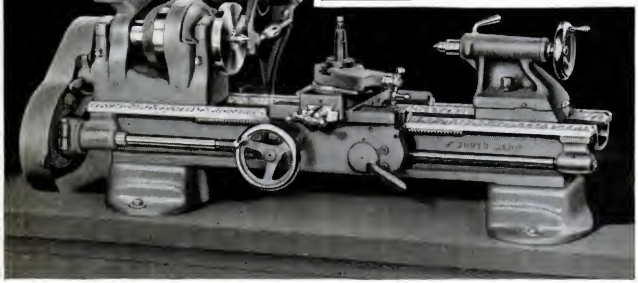
Hoot Mon! LOOK WHAT THIS LATHE WILL DO!

With this lathe and a few accessories you can turn, bore, face, thread, drill, ream, file, polish, mill, and saw all kind of metal, plastic, wood, fibre, and other materials. It is the most versatile tool you can put in your shop.



Install this fine lathe in your shop now and let it help pay for itself. Capable of a wide variety of operations, this lathe is ideal for general machine work in the small shop and for machining small parts in the large shop. A complete line of practical attachments and accessories simplify the tooling of this lathe for many special classes of work.

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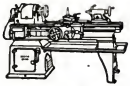

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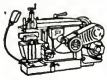

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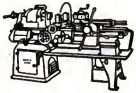

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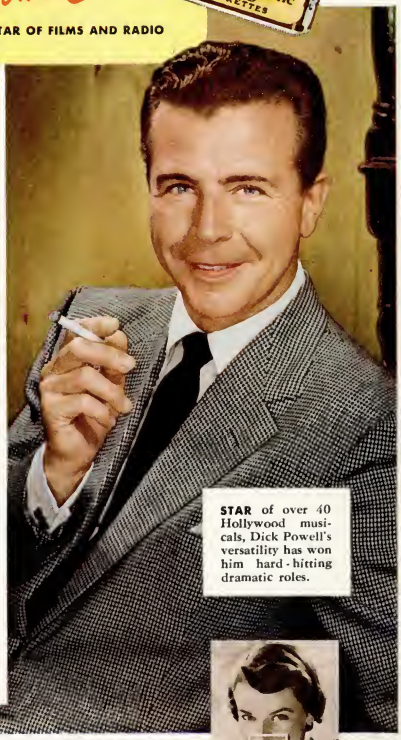

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